

Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site

K. D. Fowler

CH2M HILL Hanford Group, Inc.

Richland, WA 99352

U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: ECN 724007 R2 UC: N/A

Cost Center: 7T600

Charge Code: 502292

B&R Code: N/A

Total Pages: 253

Key Words: Tank farms, gas retention, energy ratio, buoyancy ratio, lower flammability limit, buoyant displacement, gas release event, GRE, LFL, tank classification, flammable gas hazard

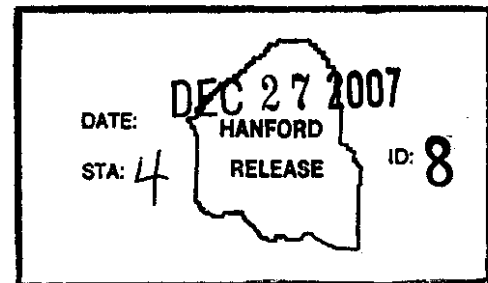
Abstract: This document categorizes each of the large waste storage tanks into one of several categories based on each tank's waste characteristics. These waste group assignments reflect a tank's propensity to retain a significant volume of flammable gases and the potential of the waste to release retained gas by a buoyant displacement event. Revision 7 is the annual update of the calculations of the flammable gas Waste Groups for DSTs and SSTs.

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

Printed in the United States of America. To obtain copies of this document, contact: Document Control Services, P.O. Box 950, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.


Release Approval

12-27-07
Date



Release Stamp

Approved For Public Release

Tank Farm Contractor (TFC)		(1) Document Number:	
RECORD OF REVISION		RPP-10006	
Page 1			
(2) Title:			
Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site			
Change Control Record			
(3) Revision	(4) Description of Change – Replace, Add, and Delete Pages	Authorized for Release	
		(5) Resp. Engr. (print/sign/date)	(6) Resp. Mgr. (print/sign/date)
0	Original Release via EDT 636634, March 22, 2003	S. A. Barker	J. Grigsby 3/22/03
1	Revision to address comments resulting from review of the Tank Farms DSA supporting documents	S. A. Barker	R. J. Stevens 8/28/03
2	Complete response to comments	S. A. Barker	R. J. Stevens 10/15/03
2A	Modify main document for clarity	S. A. Barker	R. J. Stevens 10/22/03
2B	Add Appendix M to discuss inadvertent transfer of C-200 vacuum retrieval dump to 241-C-203	S. A. Barker	R. J. Stevens 11/19/03
3	Rewrite main body of document in response to 03-TED-111 dated 10/24/03 ECN-722103-R0	S. A. Barker	T. M. Horner 7/28/04
4	Complete revision	S. A. Barker	T. M. Horner 10/27/04
5	ECN 724 R0 – Annual Update – Complete revision	S. A. Barker 7/25/06	M. A. Knight 7/25/06
6	ECN 724 R1 – Annual Update – Complete revision	T. A. Hu	N.W. Kirch 12/22/06
RS 7	ECN 724 ¹⁰⁰⁰⁷⁻ R2 – Annual Update – Complete Revision	K. D. Fowler <i>[Signature]</i> 12/20/07	N. W. Kirch <i>NWK</i> 12/21/2007

EXECUTIVE SUMMARY

The Hanford Site contains 177 large underground radioactive waste storage tanks (28 double-shell tanks and 149 single-shell tanks). These tanks are categorized into one of three waste groups (A, B, and C) based on their waste and tank characteristics. These waste group assignments reflect a tank's propensity to retain a significant volume of flammable gases and the potential of the waste to release retained gas by a buoyant displacement gas release event. Assignments of waste groups to the 177 double-shell tanks and single-shell tanks, as reported in this document, are based on a Monte Carlo analysis of three criteria.

The first criterion is the headspace flammable gas concentration following release of retained gas. This criterion determines whether the tank contains sufficient retained gas such that the well-mixed headspace flammable gas concentration would reach 100% of the lower flammability limit if the entire tank's retained gas were released. If the volume of retained gas is not sufficient to reach 100% of the lower flammability limit, then flammable conditions cannot be reached and the tank is classified as a waste group C tank independent of the method the gas is released.

The second criterion is the energy ratio and considers whether there is sufficient supernatant on top of the saturated solids such that gas-bearing solids have the potential energy required to break up the material and release gas. Tanks that are not waste group C tanks and that have an energy ratio < 3.0 do not have sufficient potential energy to break up material and release gas and are assigned to waste group B. These tanks are considered to represent a potential induced flammable gas release hazard, but no spontaneous buoyant displacement flammable gas release hazard. Tanks that are not waste group C tanks and have an energy ratio ≥ 3.0 , but that pass the third criterion (buoyancy ratio < 1.0 , see below) are also assigned to waste group B. Even though the designation as a waste group B (or A) tank identifies the potential for an induced flammable gas release hazard, the hazard only exists for specific operations that can release the retained gas in the tank at a rate and quantity that results in reaching 100% of the lower flammability limit in the tank headspace. The identification and evaluation of tank farm operations that could cause an induced flammable gas release hazard in a waste group B (or A) tank are included in other documents.

The third criterion is the buoyancy ratio. This criterion addresses tanks that are not waste group C double-shell tanks and have an energy ratio ≥ 3.0 . For these double-shell tanks, the buoyancy ratio considers whether the saturated solids can retain sufficient gas to exceed neutral buoyancy relative to the supernatant layer and therefore have buoyant displacement gas release events. If the buoyancy ratio is ≥ 1.0 , that double-shell tank is assigned to waste group A. These tanks are considered to have a potential spontaneous buoyant displacement flammable gas release hazard in addition to a potential induced flammable gas release hazard.

In determining the final waste group for a tank, uncertainty in the input data parameters used in the above calculations is accounted for by performing a Monte Carlo analysis. For each tank, 5,000 trial calculations of the waste group are performed using the criteria and method described above. For each trial, the input data for the calculations are randomly selected from pre-determined distributions that span the range of uncertainty in each parameter.

The final waste group assigned to a tank is based on a 95% confidence level of the 5,000 trials. If the tank exhibits category C behavior at the 95% confidence level or for 95% of the trials, the tank is classified as waste group C. If the tank exhibits category C behavior at less than the 95% confidence level, but exhibits combined category C and category B behavior at more than 95% confidence level, the tank is then classified as a waste group B tank. The remaining tanks, those that exhibit category A behavior for greater than 5% of the trials, are placed in the waste group A category.

Sensitivity studies of waste group assignments were also performed for the cases of water and caustic additions to the waste tanks.

Revision 7 of this document incorporates the following changes and analysis:

- Double-shell tank input data have been updated.
- Single-shell tank data have been updated to reflect Best Basis Inventory changes since Revision 6 of this document.
- Waste group calculations have been performed for the 28 double-shell tanks and for 17 of the single-shell tanks based on the updated input data. For the remaining single-shell tanks, the data previously evaluated remains applicable and new waste group calculations are not necessary.

Based on the existing evaluation methodology and data updates discussed above, the resulting flammable gas waste groups for 177 double-shell tanks and single-shell tanks are given as follows:

- For the double-shell tanks overall, there are 5 waste group A tanks, 7 waste group B tanks, and 16 waste group C tanks.
- Seventeen single-shell tanks were re-evaluated and there was no change to the waste group assignments for these tanks.
- For the remaining 132 single-shell tanks, through simple data analysis, it is concluded that the waste group assignments in RPP-10006, Rev. 5, remain unchanged.

CONTENTS

1.0	INTRODUCTION	1-1
1.1	GAS RETENTION IN SINGLE-SHELL TANKS AND DOUBLE-SHELL TANKS	1-1
1.2	GAS RELEASE EVENTS	1-2
1.3	WASTE GROUPS FOR SINGLE-SHELL TANKS AND DOUBLE-SHELL TANKS	1-3
2.0	WASTE GROUP SELECTION CRITERIA	2-1
2.1	CRITERIA USED TO ASSIGN TANKS TO A WASTE GROUP	2-1
2.2	SELECTION OF BUOYANCY RATIO CALIBRATION FACTOR	2-7
2.3	EXPLANATION OF HOW CRITERIA ARE USED	2-10
2.4	APPLICATION OF DATA TO SLUDGE TANKS	2-11
3.0	CALCULATIONAL METHODOLOGY	3-1
3.1	MONTE CARLO METHODOLOGY	3-1
3.2	RANDOM NUMBER SEED SENSITIVITY TEST	3-2
3.3	APPLICATION OF CRYSTAL BALL	3-4
3.4	ASSUMPTIONS	3-4
3.5	SOFTWARE USED	3-5
4.0	SOURCES OF INPUT DATA AND HIERARCHY	4-1
5.0	RESULTS OF CALCULATIONS	5-1
5.1	WASTE GROUP ASSIGNMENTS	5-1
	5.1.1 Double-Shell Tanks	5-8
	5.1.2 Single-Shell Tanks	5-9
6.0	REFERENCES	6-1

APPENDICES

A	WASTE TYPE EVALUATION	A-i
B	DENSITY EVALUATION	B-i
C	WASTE LAYER HEIGHT AND UNCERTAINTY DETERMINATION	C-i
D	DETERMINATION OF VOID FRACTION	D-i
E	HYDROGEN GENERATION RATES CALCULATIONS FOR BUOYANT DISPLACEMENT GAS RELEASE EVENT CRITERIA DETERMINATIONS	E-i
F	WELLS, B. E., AND S. A. BARKER, 2003, <i>SUMMARY OF YIELD STRESS IN SHEAR DATA FOR HANFORD WASTE</i> , TWS03.044, PACIFIC NORTHWEST NATIONAL LABORATORY, RICHLAND, WASHINGTON	F-i

G	DERIVATION OF RETAINED GAS COMPOSITIONS.....	G-i
H	INPUT DATA	H-i
I	PEER REVIEW CHECKLIST	I-i

LIST OF FIGURES

Figure 3-1. RPP-10006, Rev. 5, Spreadsheet and Macro Hierarchy.	3-8
--	-----

LIST OF TABLES

Table 1-1. Total Tank Retained Gas Volumes and Corresponding Release Fractions for Five Double-Shell Tanks.*	1-3
Table 2-1. Data Specific to Buoyancy Ratio Calibration. (3 sheets).....	2-8
Table 3-1. Stability Test Results (Evaluation Performed for RPP-10006, Rev. 5).	3-3
Table 4-1. Data Source Summary Table. (1 sheet).....	4-2
Table 4-2. Monte Carlo Model Dynamic Constraints.	4-3
Table 5-1. Determination of Waste Group Classification. (6 sheets).....	5-2
Table 5-2. Indicators of Buoyant Displacement Gas Release Event Behavior.	5-8
Table 5-3. Waste Group Assignments for Double-Shell Tanks.	5-8
Table 5-4. Waste Group Assignments for Single-Shell Tanks. (2 sheets)	5-10

LIST OF TERMS

BBI	<i>Best-Basis Inventory</i>
BDGRE	buoyant displacement gas release event
BPE	barometric pressure effect
DST	double-shell tank
ENRAF	Enraf-Nonius Series 854 (level gauge)
GRE	gas release event
HGR	hydrogen generation rate
LFL	lower flammability limit
PNNL	Pacific Northwest National Laboratory
RGS	retained gas sampler
SST	single-shell tank
VFI	void fraction instrument

This page intentionally left blank.

1.0 INTRODUCTION

Waste stored within tank farm double-shell tanks (DST) and single-shell tanks (SST) generates flammable gas (principally hydrogen) to varying degrees depending on the type, amount, geometry, and condition of the waste. The waste generates hydrogen through the radiolysis of water and organic compounds, thermolytic decomposition of organic compounds, and corrosion of a tank's carbon steel walls. Radiolysis and thermolytic decomposition also generates ammonia. Nonflammable gases, which act as dilutents (such as nitrous oxide), also are produced. Additional flammable gases (e.g., methane) are generated by chemical reactions between various degradation products of organic chemicals present in the tanks. Volatile and semi-volatile organic chemicals in tanks also produce organic vapors. The generated gases in tank waste are either released continuously to the tank headspace or are retained in the waste matrix. Retained gas may be released in a spontaneous or induced gas release event (GRE) that can significantly increase the flammable gas concentration in the tank headspace as described in RPP-7771, *Flammable Gas Safety Issue Resolution*.

1.1 GAS RETENTION IN SINGLE-SHELL TANKS AND DOUBLE-SHELL TANKS

Studies have shown that some tanks store significant volumes of gas in their waste. Free gas can accumulate in submerged solids, which are saturated. Convective fluid layers of waste do not retain significant amounts of insoluble gases (e.g., hydrogen and methane) because bubbles rise through liquid waste as fast as they are generated. Soluble gases (primarily ammonia) are also dissolved in liquid waste; however, evaporation of dissolved ammonia is pronounced only when a free liquid surface is freshly exposed or agitated.

Direct measurements of retained gas are not available for most tanks. Estimates of the amount of retained gas stored in each DST and SST were made based on two indirect methods provided in WHC-SD-WM-ER-526, *Evaluation of Hanford Tanks for Trapped Gas*. Based on WHC-SD-WM-ER-526, only 49 of the 177 SSTs and DSTs were determined by the barometric pressure effect (BPE) method to have trapped gas and, of these, only 15 tanks, including 4 DSTs (241-AN-103, 241-AN-104, 241-AN-105, and 241-AW-104) stored relatively large volumes of gas, greater than 10% of the solid waste volume. Sixty-eight tanks have so little waste that gas retention is of little concern. Even if all the stored gas were hypothetically released, the relatively large headspace provides significant dilution.

Both of the indirect estimation methods include significant uncertainties, as described in WHC-SD-WM-ER-594, *Evaluation of Recommendation for Addition of Tanks to the Flammable Gas Watch List*. Uncertainties arise because the models are simplified and approximate the physical condition of the waste in all DSTs and SSTs and because the data used lacks the accuracy necessary to make estimates of the retained gas. Given the uncertainty in the methods and data, a conservative assumption is that all the DSTs and SSTs retain gas in their saturated solid layers.

Retained gas estimates used in this document are based on the void fraction in the saturated solids of each tank considered. Void fraction distributions are based on all available void fraction instrument (VFI) data, retained gas sampler (RGS) data, appropriate BPE data, and similarities in waste type for the other tanks as described in Appendix A.

1.2 GAS RELEASE EVENTS

Gases released from the waste in a DST or SST in a nearly continuous manner can be managed effectively by ventilation. However, it is more difficult to manage when a significant amount of the gas retained within waste is released relatively rapidly in a buoyant displacement gas release event (BDGRE). BDGREs were observed in six of the DSTs (241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, 241-SY-101, and 241-SY-103). Data regarding the physics of GRE in the tanks is provided in Pacific Northwest National Laboratory (PNNL) documents PNNL-11296, *In Situ Rheology and Gas Volume in Hanford Double-Shell Waste Tanks*, and PNNL-11536, *Gas Retention and Release Behavior in Double-Shell Waste Tanks*. The most recent estimations of released gas volumes are found in RPP-6655, *Data Observations on Double-Shell Flammable Gas Watchlist Tank Behavior*.

The large GREs that occurred in DST 241-SY-101 before mitigation by the mixer pump, and remediation by transfers and dilution, were unique in size and frequency. The largest release was the December 4, 1991, GRE of 183 to 263 m³ of gas (RPP-6655), or 39 to 56% of its retained gas inventory.¹ The observed frequency of GREs in DST 241-SY-101, prior to remediation, was every 80 to 150 days (RPP-6517, *Evaluation of Hanford High-Level Waste Tank 241-SY-101*). In contrast, the total tank retained gas volumes (including transient and retained gas in the crust and convective layer) and corresponding release fractions for the other five GRE DSTs based on VFI and RGS data for these tanks are given in Table 1-1.

¹ DST 241-SY-101 percent gas released is based on the following calculations. The high estimate is calculated using the December 4, 1991, maximum calculated release volume, 263 m³ (RPP-6655), with a retained gas volume based on the post mixer pump retained gas volume at standard conditions, 195 m³ (RPP-6655), corrected for the difference in total waste height at the time of the GRE, 416 in. (height on December 4, 1991, from Personal Computer-Surveillance Analysis Computer System) minus post mixer pump waste height of 399 in. (RPP-6517). The volume of gas released by mixer pump operations is determined to be 177 m³ [(416 in. – 399 in.) x 2,754 gal/in. x 0.003785 m³/gal] corrected for pressure (i.e., 1.53 pressure ratio [RPP-6655]) to 271 m³. The conservative retained gas volume at tank headspace conditions on December 4, 1991, is calculated to be 466 m³ (195 m³ + 271 m³). When the maximum calculated volume of gas released is divided by the calculated retained gas volume, all volumes at headspace conditions, the calculated release volume is 56% of the retained gas volume (263 m³/466 m³). Similarly, the calculated volume for the December 4, 1991, release is 183 m³, which corresponds to 39% (183 m³/466 m³) of the retained gas volume.

Table 1-1. Total Tank Retained Gas Volumes and Corresponding Release Fractions for Five Double-Shell Tanks.*

Tank	Total retained gas volume (Standard m ³)	Release fraction
241-AN-103	393±64	0.02
241-AN-104	259±48	0.07
241-AN-105	202±68	0.15
241-AW-101	153±38	0.19
241-SY-103	198±86	0.12

Note:

*Data from Table ES-1 of RPP-7771, *Flammable Gas Safety Issue Resolution*, Rev. 0-A, CH2M HILL Hanford Group, Inc., Richland, Washington.

The uncertainties for the total retained gas volumes represent a 95% confidence bound. The release fractions were calculated by dividing maximum observed hydrogen release by total retained hydrogen volume (RPP-7771). None of the gas releases in the DSTs, other than DST 241-SY-101 prior to remediation, have been large enough to create flammable mixtures after mixing in the tank headspace as described in RPP-6517 and RPP-7771.

A study of gas retention behavior in SST waste has narrowed the number of plausible spontaneous release mechanisms to a few that are capable of only small releases (less than 10 m³ compared with 100 to 200 m³ in DST 241-SY-101). The study is discussed in HNF-SP-1193, *Flammable Gas Project Topical Report*. Observation of a number of the most active flammable-gas-retaining SSTs indicates that no large BDGREs are occurring and that only a few SSTs experience small spontaneous GREs. The typical spontaneous GRE in an SST has a small release volume of tens of cubic feet of hydrogen and no release in the SSTs has been observed with the "classic" BDGRE properties as described in RPP-7771 and RPP-7249, *Data and Observations of Single-Shell Flammable Gas Watch List Tank Behavior*. The variation in gas release volumes and fractions within the same tank are a good indication of tank waste inhomogeneity and supports the use of uncertainty distributions for the modeling of this type of behavior.

1.3 WASTE GROUPS FOR SINGLE-SHELL TANKS AND DOUBLE-SHELL TANKS

Waste group assignments have been developed for the 177 DSTs and SSTs for application of flammable gas controls. The SST and DST groupings are based on waste tank characteristics and the propensity of the waste to experience a large BDGRE. Waste group selection criteria were developed based on both empirical data and analytical concepts with the objective of identifying and separating waste tanks into groups that posed similar GRE risks.

The SSTs and DSTs are assigned to one of three groups as described below:

- **Waste Group C:** Tanks with no potential GRE flammable gas hazard. That is, tanks that are conservatively estimated to contain insufficient retained gas to achieve 100% of the lower flammability limit (LFL), even if all of the retained gas is released into the tank headspace.
- **Waste Group B:** Tanks with a potential induced GRE flammable gas hazard, but no potential spontaneous BDGRE flammable gas hazard. That is, tanks that are conservatively estimated to contain sufficient retained gas to achieve 100% of the LFL if all of the retained gas is released into the tank headspace, but are not waste group A tanks (see below).

Note : Potential induced GRE flammable gas hazards exist in waste group B (and A) tanks only for specific operations that can release the retained gas in the tank at a rate and quantity that results in reaching 100% of the LFL in the tank headspace. The identification and evaluation of tank farm operations that could cause an induced flammable gas release hazard in a waste group B (or A) tank are included in other documents.

- **Waste Group A:** Tanks with a potential spontaneous BDGRE flammable gas hazard in addition to a potential induced GRE flammable gas hazard. That is, tanks that are conservatively estimated to achieve a flammable gas concentration of 100% of the LFL in the tank headspace if all of the retained gas is released from a spontaneous BDGRE.

2.0 WASTE GROUP SELECTION CRITERIA

2.1 CRITERIA USED TO ASSIGN TANKS TO A WASTE GROUP

The waste parameters or combinations of waste parameters that are used to assign individual SSTs and DSTs to waste groups are as follows.

Headspace Flammable Gas Concentration Following Release of Retained Gas: This criterion determines whether the tank contains sufficient retained gas such that the well-mixed headspace flammable gas concentration would reach 100% of the LFL if the entire tank's retained gas were released. If there is not sufficient retained gas to reach 100% of the LFL, then flammable conditions cannot be reached and the tank is classified as a waste group C tank independent of the gas release method.

The saturated settled solids depth² and gas volume fraction distribution can be used to determine whether there is sufficient retained gas in the waste to cause the tank headspace to become flammable if the gas were instantaneously released. The sediment gas volume fraction may be determined using void fraction data, assigned conservative bounding values, or conservatively calculated as the neutral buoyancy gas fraction (for tanks with liquid-over-sediment waste configuration). This calculation can be used as a quick screen for determining whether a tank poses a potential GRE hazard and does not model expected tank behavior. Equations 1, 2, and 3 are used to make these calculations relating to headspace flammable gas concentration criterion.

In Equation 3, the pressure on the retained gas is determined. The slightly conservative assumption is made that the gas is stored as particle-displacing bubbles (hydro-dendritic bubbles or lithostatic conditions). The depth of the crust, if continuous across the surface, is added to the convective layer depth to determine the pressure contribution from these layers. Because the amount of crust floating above the liquid is not measured, the full crust level is used in the pressure calculation. In addition, it is assumed that the crust has the same density as the convective layer. For tanks with a noncontiguous crust and for which the convective layer surface level is known, there is no need to add the depth of the crust, since the effect of the crust layer would be included in the convective layer surface level.

² Saturated settled solids depth is considered in the retained gas volume determination versus the depth of solids saturated with liquid. The difference is that the volume of saturated solids in a floating crust layer is not included. This simplification is reasonable for several reasons. First, the existing crusts in the DSTs are less than 1 m thick (Appendix H) and only approximately one half of this depth is saturated with liquid and capable of retaining flammable gas. Second, the retained gas within the crust does not have the same pressure head as the retained gas within the main body of solids, because the liquid layer, which contributes a significant portion of the retained gas pressure head, is below the crust layer. The effective head pressure on the retained gas in the settled solids ranges from 1.7 to 2.3 atmospheres (RPP-6655) when compared to the head pressure on the crust retained gas of about 1 atmosphere. These considerations indicate that the crust's retained gas volume at headspace conditions is small relative to the settled solids retained gas volume. Finally, floating crusts are currently only found in waste group A tanks and would have no impact on the final classification of the tank.

Retained Gas Flammability at Headspace Criterion %LFL_{HS} : %LFL_{HS} > 100%

$$\%LFL_{HS} = \left(\frac{[H_2]_{RG}}{\%LFL_{H_2}} + \frac{[CH_4]_{RG}}{\%LFL_{CH_4}} + \frac{[NH_3]_{RG}}{\%LFL_{NH_3}} \right) * \frac{VG_{WNCL} * F_{GasRelease}}{V_{HS}} \quad (1)$$

Where

$$VG_{WNCL} = VF_{WNCL} * A * H_{WNCL} * \left(\frac{P_{WNCL}}{P_{HS}} \right) * \left(\frac{T_{HS}}{T_{WNCL}} \right) \quad (2)$$

$$P_{WNCL} = P_{HS} + \rho_{CL} * g * (H_{CL} + H_{CR} + 0.5 * H_{WNCL}) \quad (3)$$

%LFL_{CH4} = methane concentration at 100% LFL (5.0 vol%)

%LFL_{H2} = hydrogen concentration at 100% LFL (4.0 vol%)

%LFL_{HS} = headspace flammable gas concentration following gas release

%LFL_{NH3} = ammonia concentration at 100% LFL (15.0 vol%)

[CH₄]_{RG} = methane concentration in the retained gas in nonconvective layer (vol%)

[H₂]_{RG} = hydrogen concentrations in the retained gas in nonconvective layer (vol%)

[NH₃]_{RG} = ammonia concentration in the retained gas in nonconvective layer (vol%)

A = cross-sectional area of tank (m²)

F_{GasRelease} = fraction of gas released (assumed to be 100%)

g = gravity acceleration 9.806 m/sec²

H_{CL} = height of the liquid (convective) layer (m)

H_{CR} = height of the crust layer (m)

H_{WNCL} = height of liquid saturated nonconvective layer (m)

P_{HS} = pressure in tank headspace and assume the pressure is 1 atm = 101,325 Pa (or N/m²)

P_{WNCL}	=	calculated representative retained gas pressure in saturated settled solids layer in atm or Pa (N/m^2)
T_{HS}	=	representative temperature of headspace of waste tank (K)
T_{WNCL}	=	representative temperature of saturated settled solids layer (K)
VF_{WNCL}	=	representative void fraction in saturated settled solids layer
VG_{WNCL}	=	calculated volume of gas retained in the saturated settled solids layer at headspace conditions (m^3)
V_{HS}	=	volume of headspace of waste tank after gas release (m^3)
ρ_{CL}	=	density of convective layer (kg/m^3).

Note 1: Temperatures used are the maximum daily average layer temperatures recorded over the previous 12 months within the solid waste or within the vapor space as appropriate and are obtained from RPP-5926.

Note 2: The dilution of released gases by water vapor is not considered.

Note 3: Uncertainty distributions are utilized to account for the scatter of retained gas volumes in the waste and uncertainty in the solid volumes. Void fraction distributions are based on all available VFI data, RGS data, and appropriate BPE data.

Energy Ratio: The presence of a significant supernatant layer introduces the possibility of BDGREs. The supernatant layer depth can be utilized as a criterion for determining susceptibility to BDGREs by using a term called “energy ratio” as described in PNNL-11296. The waste in tanks with supernatant layers below an energy ratio threshold of about 3 is not expected to contain sufficient energy to release gas during a buoyant displacement event.

If a tank’s waste fails the retained gas volume criterion, the energy ratio criterion is applied. The process of gas release from a gob undergoing buoyant displacement requires that sufficient energy be released to disrupt the waste surrounding the bubbles to allow them to escape as the gob reaches the waste surface. The amount of energy available is directly proportional to the depth of the supernatant through which the gob rises.

The energy ratio is the ratio of the buoyant potential energy of the gas-bearing gobs to the energy required to yield the waste and release gas from those gobs participating in buoyant displacements. The depth of the convective layer above a nonconvective layer in a tank’s waste determines whether gas retained in gobs from the saturated nonconvective layer can be released.

Equations 4, 5, and 6 are used for energy ratio calculations. If the energy ratio for the waste in a DST or SST is less than 3, for a tank that can reach 100% of the LFL in the headspace based on the calculation in Equation 1, then that tank is classified as a waste group B tank. The DSTs that fail both the retained gas volume criterion and the energy ratio criterion are examined for

tendencies to have spontaneous BDGREs. The criterion comparison value of 3 accounts for the energy needed to overcome the yield stress, plus a factor to account for energy lost through other processes during the gas release. Based on experimental observations and tank behavior, some gas can be released when the energy ratio exceeds 3, and release of a large fraction of stored gas can occur when the energy ratio exceeds 5. Although the effect of the critical void fraction is discussed in PNNL-13782, *Analysis of Induced Gas Releases During Retrieval of Hanford Double-Shell Tank Waste*, it requires knowledge of the value for the yield stress, which is accurately known only in tanks where the ball rheometer has been used for in-situ determinations of yield stress. In tanks where this value has not been measured, the uncertainty introduced by estimating this value is not justified, and the neutral buoyancy void fraction is used. In addition, for weak waste, the critical void fraction approaches the neutral buoyancy void fraction.

Energy Ratio Criteria ER: $ER < 3.0$

$$ER = \left(\frac{\alpha_{NB} * \gamma * P_{HS}}{(1 - \alpha_{NB}) * \tau_{WNCL} * \epsilon_y} \right) * \left(\left(1 + \frac{1}{\gamma} \right) * \ln(1 + \gamma) - 1 \right) \quad (4)$$

where

$$\gamma = \frac{\rho_{CL} * g * (H_{CL} + H_{CR})}{P_{HS}} \quad (5)$$

$$\alpha_{NB} = 1 - \frac{\rho_{CL}}{\rho_{WNCL}} \quad (6)$$

ER = energy ratio, the ratio of the buoyant potential energy of the gas-bearing gobs to the energy required to yield the waste and release gas from those gobs participating in buoyant displacements

g = gravity acceleration, 9.806 m/sec^2

H_{CL} = height of the liquid (convective) layer (m)

H_{CR} = height of the crust layer (m)

P_{HS} = pressure in tank headspace, assuming the pressure is 1 atm = 101,325 Pa (or N/m^2)

α_{NB} = calculated or measured neutral buoyancy of saturated settled solids layer relative to the convective layer on top of it (calculated neutral buoyancy is one minus the ratio of convective layer density to saturated non-convective layer density)

γ = calculated ratio of pressure head of convective layer in a waste tank to the headspace pressure, which is assumed to be one atmosphere

- ρ_{CL} = density of convective layer (kg/m^3)
 ρ_{WNCL} = density of saturated non-convective layer (kg/m^3)
 τ_{WNCL} = representative yield stress of saturated non-convective layer (Pa)
 ϵ_y = nonconvective layer strain at failure (assumed to be 1).

Only saltcake/salt slurry tanks have exhibited BDGRE behavior. For reasons given in Section 2.4, the energy ratio is considered valid for both saltcake/salt slurry and sludge tanks.

An energy ratio of 3 is the decision criterion specified in PNNL-13781, *Effects of Globally Waste-Disturbing Activities on Gas Generation, Retention, and Release in Hanford Waste Tanks*.

Buoyancy Ratio: This is a semi-empirical relation presented in PNNL-13337, *Preventing Buoyant Displacement Gas Release Events in Hanford Double-Shell Waste Tanks*, and updated in PNNL-15238, *Predicting Peak Hydrogen Concentrations from Spontaneous Gas Releases in Hanford Waste Tanks*, which estimates the average waste gas fraction based on a balance of gas generation and background release. The buoyancy ratio represents the average saturated settled solids (nonconvective) layer gas fraction divided by the neutral buoyancy gas fraction. This physics-based buoyancy model was developed from the theory of bubble transport. This model predicts whether there is sufficient gas build up in the saturated settled solids layer in a DST to make gobs of waste buoyant and produce BDGREs (PNNL-13337). If the average void fraction in the saturated settled solids layer of waste is less than the neutral buoyant void fraction, a BDGRE cannot occur. Conversely, an average void fraction greater than the neutral buoyant void fraction predicts that BDGREs will occur prior to reaching steady state. The ratio of the average steady-state void fraction to the neutral buoyant void fraction for the case of constant nucleation is given by Equation 7. The constant in the numerator of the first factor is adjusted so that the minimum buoyancy ratio for DSTs experiencing BDGREs is 1.00. In this report, DST 241-AN-103 is used to calculate the constant.

Buoyancy Ratio Criterion BR: $BR < 1$

$$BR = \left(\frac{CF}{\rho_{WNCL} - \rho_{CL}} \right) * \left(\frac{\left(\frac{HG_{WNCL}}{[H_2]_{RG}} * T_{WNCL} \right)^{\frac{1}{3}}}{P_{WNCL}} \right) * H_{WNCL}^2 \quad (7)$$

$[H_2]_{RG}$ = hydrogen concentrations in the retained gas in nonconvective layer (vol%)

BR	= buoyancy ratio, the average saturated settled solids layer gas fraction divided by the neutral buoyancy gas fraction. This ratio predicts whether there is sufficient gas buildup in the saturated settled solids layer in a DST to make gobs of waste buoyant and produce BDGREs
CF	= calibration factor contains all the constants along with unknowns, determined empirically from tank data [set to $1,075 \text{ (kg/m}^4\text{) (day-Pa/mole-K)}^{1/3}$ or $23.059 \text{ (kg/m}^4\text{) (day-atm/mole-K)}^{1/3}$]
H_{WNCL}	= hydrogen generation rate (HGR) in saturated settled solids layer (moles/m ³ /day)
H_{WNCL}	= height of liquid saturated non-convective layer (m)
P_{WNCL}	= calculated representative retained gas pressure in saturated settled solids layer in atm or Pa (N/m ²)
T_{WNCL}	= representative temperature of saturated settled solids layer (K)
ρ_{CL}	= density of convective layer (kg/m ³)
ρ_{WNCL}	= density of saturated non-convective layer (kg/m ³).

Note 1: Temperatures used are the maximum temperatures recorded over the previous 12 months within the solid waste or within the vapor space as appropriate and are obtained from RPP-5926, Rev. 7.

Note 2: Uncertainty distributions are utilized to account for the scatter of retained gas volumes in the waste and uncertainty in the solid volumes. Void fraction distributions are based on all available VFI data, RGS data, and appropriate BPE data.

Note 3: The calibration factor (CF) is $(3/16)(N^{2/3} R^{1/3} m_{\tau}/(SKg))$ and includes the parameters N (the bubble nucleation rate per unit volume), R (the gas constant), m_{τ} (the slope of the yield stress versus depth curve representing the ball rheometer data), S (the proportionality constant in Stokes flow), K (the unknown proportionality constant between the unknown effective viscosity and the yield stress), and g (acceleration due to gravity).

Note 4: The total gas generation, G, in buoyancy ratio (Equation 7) is estimated by the HGR divided by the fraction of hydrogen generation. However, the data of hydrogen fraction in retained gas is used because of the lack of data on the hydrogen generation fraction in total gas generation.

The buoyancy ratio criterion is not applicable for SSTs since it is a semi-empirical relation based on BDGRE experience in DSTs. Therefore, large water additions (> 10,000 gal for 100-series tanks, > 1,000 gal for 200-series tanks) to SSTs that could lead to failing the first two criteria (i.e., retained gas volume and energy ratio) are prohibited until re-evaluated. This prevents the creation of an SST with an unknown and unanalyzed GRE flammable gas hazard.

The buoyancy ratio model is sensitive at conditions where the convective layer and nonconvective layer densities are close. Layer buoyancy is dependent on the amount of gas required to balance (or overcome the balance of) the densities of the two layers. Physically, as the densities of the two layers invert, the nonconvective layer will become buoyant and will rise to the surface releasing its gas. It should be noted that the nonconvective layer also has to have sufficient potential energy to overcome the yield strength of the solid particles to release as a gob.

2.2 SELECTION OF BUOYANCY RATIO CALIBRATION FACTOR

The buoyancy ratio was developed to describe the relationship between DSTs that historically exhibited BDGRE behavior. It was found that tanks exhibiting BDGRE behavior have a relationship between the average saturated settled solids layer gas fraction and the neutral buoyancy gas fraction that is greater than the ratio of these values determined for tanks that never exhibited BDGREs. This buoyancy ratio is used to predict whether there is sufficient gas buildup in the saturated settled solids layer in a DST to make gobs of waste buoyant and produce BDGREs. It was determined that tanks with documented BDGREs would have buoyancy ratios greater than 1 (where the calibration factor was set such that the lowest buoyancy ratio for a tank exhibiting BDGRE behavior would be unity) (PNNL-13337).

The buoyancy ratio calibration factor is set based on the median properties for each DST which exhibits BDGRE behavior. However, whether or not a tank is classified as a waste group A tank is based on the 95% confidence level for a given set of current tank conditions (the Monte Carlo analysis). The methodology for calculating convective layer densities has changed since the 1990s and has been incorporated in the rebaselined buoyancy ratio calibration factor. In addition, there have been some changes in the method used to determine the convective layer specific gravities due to adjustments when dealing with solids that precipitate upon sample cooling after removal from the tank. The results of this calibration factor determination will be used for all future waste group analyses unless there is a significant change in the buoyancy ratio formula.

Data in Table 2-1 were taken from the following sources: the total waste depth (RPP-6655), the nonconvective layer depth (PNNL-15238), the crust depth (RPP-6655), the convective layer depth (by difference), the layer densities (PNNL-15238), and the HGRs (RPP-5926, Rev. 0). Yield stress data and the percent void information were based on information used in Revision 5 of this document. Data were first used to find the BDGRE tank with the lowest buoyancy ratio and then the calibration factor was adjusted until the buoyancy ratio calibration factor equaled 1. DST 241-AN-103 was determined to be the BDGRE tank with the lowest buoyancy ratio. The calibration factor was calculated to be $1,075 \text{ (kg/m}^4 \text{) (day-Pa/mole-K)}^{1/3}$, where the buoyancy

ratio for 241-AN-103 was set to 1. Buoyancy ratio calculations for all five historical BDGRE tanks are presented in Table 2-1.

Table 2-1. Data Specific to Buoyancy Ratio Calibration. (3 sheets)

Tank	Median buoyancy ratio with calibration factor = 1075	Total waste depth (m) ^a	Total waste depth uncertainty (m) ^b	Total nonconvective waste depth (m) ^c	Total nonconvective waste depth uncertainty (m) ^c
241-AN-103	1.00	8.84	0.080	3.79	0.290
241-AN-104	1.75	9.79	0.035	3.96	0.310
241-AN-105	2.13	10.41	0.050	4.36	0.154
241-AW-101	1.46	10.40	0.100	2.89	0.287
241-SY-103	1.87	6.91	0.065	3.26	0.395
Tank	Total nonconvective waste depth lower bound (m) ^d	Wetted nonconvective waste depth (m) ^e	Wetted nonconvective waste depth uncertainty (m) ^e	Wetted nonconvective waste depth lower bound (m) ^e	Convective waste depth (m) ^f
241-AN-103	0.010	3.79	0.290	0.010	4.17
241-AN-104	0.010	3.96	0.310	0.010	5.42
241-AN-105	0.010	4.36	0.154	0.010	5.60
241-AW-101	0.010	2.89	0.287	0.010	6.71
241-SY-103	0.010	3.26	0.395	0.010	3.07
Tank	Convective waste depth uncertainty (m)	Mean crust depth (m) ^a	Convective waste density mean (kg/m ³) ^g	Convective waste density std dev (kg/m ³) ^g	Convective waste density min (kg/m ³) ^g
241-AN-103	NA	0.89	1,497	34	1,390
241-AN-104	NA	0.41	1,403	34	1,339
241-AN-105	NA	0.45	1,417	46	1,330
241-AW-101	NA	0.80	1,443	39	1,370
241-SY-103	NA	0.58	1,474	46	1,352
Tank	Convective waste density max (kg/m ³) ^g	Convective waste density dist (kg/m ³) ^h	Nonconvective waste density mean (kg/m ³) ⁱ	Nonconvective waste density std dev (kg/m ³) ⁱ	Nonconvective waste density min (kg/m ³) ⁱ
241-AN-103	1,559	Normal	1,733	106	1,590
241-AN-104	1,500	Normal	1,578	45	1,520
241-AN-105	1,534	Normal	1,585	45	1,520
241-AW-101	1,524	Normal	1,570	27	1,540
241-SY-103	1,529	Normal	1,592	40	1,510

Table 2-1. Data Specific to Buoyancy Ratio Calibration. (3 sheets)

Tank	Nonconvective waste density max (kg/m ³) ⁱ	Nonconvective waste density dist (kg/m ³) ^h	Void percent or maximum wetted solids void percent mean (%) ^j	Void percent or maximum wetted solids void percent uncertainty (%) ^j	Void percent or maximum wetted solids void percent minimum (%) ^j
241-AN-103	1,930	Normal	10.700	5.35	0.01
241-AN-104	1,710	Normal	6.200	3.1	0.01
241-AN-105	1,660	Normal	4.200	2.1	0.01
241-AW-101	1,600	Normal	4.700	2.35	0.01
241-SY-103	1,634	Normal	6.000	3.000	0.00
Tank	Void percent or maximum wetted solids void percent maximum (%) ^j	Void percent or maximum wetted solids void percent dist type (%) ^j	Nonconvective waste yield stress mean (Pa) ^k	Nonconvective waste yield stress std dev (Pa) ^k	Nonconvective waste yield stress min (Pa) ^l
241-AN-103	15.11	Normal	144	13.87	88.52
241-AN-104	15.11	Normal	144	13.87	88.52
241-AN-105	15.11	Normal	144	13.87	88.52
241-AW-101	15.11	Normal	144	13.87	88.52
241-SY-103	15.11	Normal	144	13.87	88.52
Tank	Nonconvective waste yield stress max (Pa) ^m	Nonconvective waste yield stress dist type (Pa) ^k	Hydrogen generation rate in nonconvective waste (moles/m ³ /day) ⁿ	Hydrogen generation rate in nonconvective waste min (moles/m ³ /day) ^o	Hydrogen generation rate in nonconvective waste max (moles/m ³ /day) ^p
241-AN-103	199.48	Normal	1.26E-03	6.30E-04	2.52E-03
241-AN-104	199.48	Normal	1.62E-03	8.09E-04	3.24E-03
241-AN-105	199.48	Normal	2.02E-03	1.01E-03	4.04E-03
241-AW-101	199.48	Normal	1.82E-03	9.08E-04	3.63E-03
241-SY-103	199.48	Normal	1.68E-03	8.38E-04	3.35E-03

Table 2-1. Data Specific to Buoyancy Ratio Calibration. (3 sheets)

Notes:

- ^a Source is RPP-6655, Table 5.1.
- ^b Source is RPP-6655, Table 5.1. One-half of crust layer uncertainty (it is assumed that the crust is 50% submerged and only one-half of the uncertainty would be applied to the total waste depth).
- ^c Source is PNNL-15238, Table 3.6.
- ^d Value assumed to keep Monte Carlo within positive range.
- ^e Value is set to the non-convective waste depth for tanks with a convective waste layer.
- ^f Calculated by difference.
- ^g Source is PNNL-15238, Table 3.2.
- ^h It is assumed that the density samples are from a Normal distribution.
- ⁱ Source is PNNL-15238, Table 3.3.
- ^j Appendix D, Table D-13.
- ^k Appendix F.
- ^l Mean – (4 x standard deviation.)
- ^m Mean + (4 x standard deviation.)
- ⁿ Source is RPP-5926, Table A-3, converted to proper units.
- ^o $HGR(\text{mean}) / 2$.
- ^p $HGR(\text{mean}) \times 2$.

PNNL-15238, 2005, *Predicting Peak Hydrogen Concentrations from Spontaneous Gas Releases in Hanford Waste Tanks*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

RPP-5926, 2000, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-6655, 2000, *Data Observations on Double-Shell Flammable Gas Watchlist Tank Behavior*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

NA = not applicable.

2.3 EXPLANATION OF HOW CRITERIA ARE USED

First the retained gas criterion is applied. If there is not enough retained gas in the waste to allow the tank headspace to reach 100% of the LFL, the tank “passes” and is classified as a waste group C tank. No further calculations are performed. If there is sufficient retained gas in the waste to allow the tank headspace to reach 100% of the LFL, the tank “fails.” The retained gas criterion determines either that a tank is a waste group C tank (passes criterion) or it is a waste group A or B tank and the next criterion must be applied.

The energy ratio criterion is used next. The energy ratio criterion is the ratio of the buoyant potential energy for gas-bearing gobs to the energy required to yield the waste and release gas from those gobs participating in buoyant displacements. If the ratio is less than 3, the tank “passes” the criterion, the tank is classified as a waste group B tank, and no further calculations are performed. If the energy ratio is equal to or greater than 3, the buoyancy ratio criterion is applied. Failing the energy ratio criterion does not make a tank a BDGRE tank. It only says that there is enough buoyant potential energy to support a BDGRE if all the other factors are present. A tank that fails the energy ratio criterion is still a waste group A or waste group B tank and the next criterion is evaluated.

The buoyancy ratio criteria separates the waste group A and waste group B tanks. This criterion predicts whether there is sufficient gas buildup in the saturated settled solids layer in a DST to make gobs of waste buoyant and produce BDGREs. If the answer is yes, the tank "fails" and is classified as a waste group A tank. If the answer is no, the tank passes and is classified as a waste group B tank.

2.4 APPLICATION OF DATA TO SLUDGE TANKS

In 1996, PNNL-11391, *Gas Retention and Release Behavior in Hanford Single-Shell Waste Tanks*, reported the results of investigations into the gas retention and release behavior of SSTs. It was reported that, given the proper configuration of the materials in the tank, a buoyant displacement was possible in sludge-type materials. In practical experience at the Hanford Site, BDGREs have only been observed in tanks containing saltcake/salt slurry wastes with overlaying supernatant liquid.

The findings (PNNL-11391) were based on bench-scale experiments using Bentonite clay as a simulant for SST sludge materials. The tank used in the experiments was 27 cm in diameter. In the experiment, gases retained in the solids and driving the BDGREs were generated relatively quickly using the decomposition of hydrogen peroxide. The bench-scale observations were then used in the development of the energy ratio criterion, which was found to be applicable to tanks with a significant supernatant layer. When the energy ratio was applied to Hanford DST waste, it was found to be a good predictor of the energetics of buoyant displacements.

The only Hanford tanks to exhibit BDGRE behavior as predicted by the buoyancy ratio are tanks containing saltcake/salt slurry wastes. Because the Hanford tanks containing sludge materials have not historically warranted additional investigation into their behavior with respect to flammable gas retention and release, there is very little data pertaining to these tanks. It has not been demonstrated that the BDGRE prediction criteria, the energy ratio and the buoyancy ratio, apply to the sludge tanks. However, because the original experiments from which the theory of buoyant displacements was developed used sludge simulants, it is assumed that applying the energy criteria will provide a conservative estimation of the propensity of the sludge wastes to exhibit BDGRE behavior.

The buoyancy ratio has been developed using the physics of gas retention and release independent of waste type. The use of the buoyancy ratio to evaluate sludge tanks at the Hanford Site has only predicted non-BDGRE behavior in sludge tanks correctly. Since BDGREs are absent in sludge tanks, no method is available to calibrate the buoyancy ratio model to include sludge wastes. The effect of waste type is reflected by the calibration of the model, which is done on the set of saltcake/salt slurry BDGRE tanks at the Hanford Site.

3.0 CALCULATION METHODOLOGY

Tank waste data are available from a variety of sources. Regardless of the source, tank waste information has a degree of uncertainty associated with its value. The size of property or measurement uncertainty is affected by a number of factors, such as the heterogeneous nature of the waste, uncertainties due to the analysis methodology and measuring devices, and incomplete or missing data. In order to account for uncertainty in the data, the values used in this study have been assigned distributions that reflect the uncertainty in the estimation of the various tank waste properties. To perform the calculations necessary to utilize data expressed as distributions, a statistical method known as the Monte Carlo methodology was utilized in this study.

3.1 MONTE CARLO METHODOLOGY

The Monte Carlo methodology is a statistical calculation method. In this method, parameters expressed as distributions are sampled repeatedly and the single-point calculation is run many times to produce a result that is a distribution accounting for the ranges of all of the individual data parameters. In the Monte Carlo analysis, the analyst selects the number of simulation runs to perform, 'n'. A random number table is produced, which allows the calculation to select 'n' discrete values from a given input distribution. These values are then used in 'sampled' order to perform the calculation. This process is repeated for each distribution in the calculation. After this selection is completed, 'n' values have been selected from each distribution. If 'n' is sufficiently large, the frequency of the selected values mirrors the frequency of the values in the original distribution. The 'sampled' values are then used in the order of selection (not in numerical order) in the single-point calculation. The results of the 'n' single-point calculations form a distribution that will reflect the combined uncertainties from the original data. One of the advantages of the Monte Carlo simulation is that bounding property data can be used in the evaluation, but the likelihood of bounding data for all properties to be used simultaneously is very small, therefore, physically unrealistic conditions are less likely to be the basis for a decision.

A confidence level of 95% was chosen for the selection criteria prior to the start of the evaluation in order not to presuppose the result of this analysis. Selecting a confidence level allows bounding property data to be used in the evaluation. While the likelihood of a Monte Carlo simulation result using bounding data for all properties simultaneously is very small, providing a confidence level will limit decisions based on combinations of many physically bounding conditions. On the other hand, the possibility of making a nonconservative waste group assignment is reduced by the conservative assumption that 100% of the gas is released. Past experience with all tanks indicates that the largest observed gas release is on the order of 56% of the retained gas (see Section 1.2). Except for releases from DST 241-SY-101 (preremediation), the largest gas release reported in RPP-7771 was 19% in DST 241-AW-101 (see Section 1.2, Table 1-1).

3.2 RANDOM NUMBER SEED SENSITIVITY TEST

This evaluation was performed for Revision 5. It includes distributions with uncertainties for 13 parameters. The uncertainty accounts for variability in waste measurements, waste properties, and retained gas volumes and compositions. Each analysis is performed with 5,000 trials. This involves 5,000 randomly sampled values from each of the 13 distributions for a total of 65,000 data points. These values are then combined in the order they are sampled and are used in the model calculation to create a population of results with 5,000 answers that are combined to produce the result distributions. If the number of runs selected is large enough, the results of the Monte Carlo simulation can be run many times with different sets of randomly selected values and the resulting distribution will vary within limits acceptable to the analysis. To test the stability or reproducibility of the model, DST 241-SY-103 and SST 241-TX-105 were selected for evaluation. These tanks were the tanks closest to the boundary between waste groups A and B for DSTs and B and C for SSTs, respectively.

The stability test checks the operation of the model using different “seed” numbers from the random number generation algorithm. This study ran the DST 241-SY-103 and SST 241-TX-105 models 50 times each, with 5,000 trials per run. Fifty 5,000-trial runs equates to 250,000 trials using 3,250,000 data points.

The initial analysis (5,000 trials) for DST 241-SY-103 resulted in 2.38% of the trials indicating tank 241-SY-103 is a waste group A tank, 5.6% indicating waste group B, and 92.02% indicating waste group C. Since less than 95% of the trials were classified as a waste group C tank, DST 241-SY-103 would not be a waste group C tank but would be either a waste group B or waste group A tank. Since less than 5% of the trials indicated the tank would be a waste group A tank, DST 241-SY-103 would be classified as a waste group B tank. The stability test gave a mean value of 2.33% waste group A and a median value of 2.33% waste group A. The range of results of 0.76% (1.96% A to 2.72% A) for 5,000 trials is adequate for a screening criteria. Based on the stability test, DST 241-SY-103 would be classified as a waste group B tank 50 times; the tank would be classified as a waste group A tank for the “as is” case zero times. As a further stability test, 25 runs, with 50,000 trials per run, were performed. This test gave a mean and median value of 2.33% and 2.35% waste group A. The range of results was reduced to 0.24% (2.18% A to 2.42% A) for the 25 50,000 trial runs. Table 3-1 summarizes the stability tests for this tank.

The results for SST 241-TX-105 are shown in Table 3-1. The initial analysis (5,000 trials) for SST 241-TX-105 resulted in 95.04% of the trials indicating that tank SST 241-TX-105 is a waste group C tank. The stability test gave a mean value of 94.64% waste group C and a median value of 94.65% in waste group C, thus the conclusion of the stability test is that SST 241-TX-105 is a waste group B tank. The range of the results of the stability test for SST 241-TX-105 is about 1.2% (94.00% C to 95.20% C).

Table 3-1. Stability Test Results (Evaluation Performed for RPP-10006, Rev. 5).

Tank	DST 241-SY-103	SST 241-TX-105
Value tracked	Confidence level tank is a waste group A tank	Confidence level tank is a waste group C tank
Initial run	2.38 (this value is less than the 5 required to classify this tank as a waste group A tank)	95.04 (this value is more than the 95 required to classify this tank as a waste group C tank)
	"As is"	"As is"
Number of repetitions	50	50
Number of trials per repetition	5,000	5,000
Mean	2.33	94.64
Median	2.33	94.65
Standard deviation	0.18	0.27
Minimum	1.96	94.00
Maximum	2.72	95.20
Range of results	0.76	1.20
Number of repetitions	25	NA
Number of trials per repetition	50,000	
Mean	2.33	
Median	2.35	
Minimum	2.18	
Maximum	2.42	
Range of results	0.24	

Notes:

The confidence level that DST 241-SY-103 is a waste group A tank is less than 5%.

DST = single-shell tank.

NA = not applicable.

SST = single-shell tank.

Based on the range of results for both DST 241-SY-103 and SST 241-TX-105, any screening run result that is within 1.5 percentage points of 95% or within 1.5 percentage points of 5% if testing for waste group A, should be rerun with 50,000 trials. In the second run of 50,000 trials, any case within 0.5 percentage points of 95% (or 5% for waste group A) should be classified as the more conservative waste group.

As a result of these sensitivity studies and the uncertainty of the results, any result testing for waste group B or C, DST or SST, within 1.5 percentage points of 95% (between 95 to 96.5%) should be rerun using 50,000 trials. For the 50,000 trial rerun, any case within 0.5 percentage points of 95% (between 95 to 95.5%) should be classified as the more conservative waste group.

3.3 APPLICATION OF CRYSTAL BALL³

Crystal Ball is an Excel⁴ add-in, which performs data sampling and handling for the Monte Carlo simulation. Appropriate distributions are selected and defined as assumptions in the Crystal Ball analysis. The model-calculated results of interest are determined and defined as forecast values. The number of runs and random number seed value (optional) are also selected to control the selection of random numbers and termination of the program. Crystal Ball will generate a table of random numbers sufficiently large to randomly sample all distributions once for each run. The number of random numbers in the table is the product of the number of distributions and number of runs. Crystal Ball will then sample each distribution based on its random number and perform the model calculation once for each run. The individual run results are kept and a product or forecast distribution is calculated at the completion of the simulation. Crystal Ball can graphically display the forecast distributions as the runs are performed and then produce a report as desired.

3.4 ASSUMPTIONS

The following assumptions are used in this methodology.

- Gas releases are rapid with respect to the ventilation rate.
- One hundred percent of the gas is released.
- The BDGRE models apply to sludge-waste tanks.
- An energy ratio of 3 indicates that a BDGRE is capable of releasing retained gas. Experimental data and tank observations indicate that an energy ratio of 5 or greater is required to produce a significant gas release.
- In-situ measurements of yield stress are not readily available. The distribution for yield stress is conservative towards favoring BDGRE behavior as indicated by the energy ratio.
- Assume the gas is retained under hydrostatic conditions (the solids are self-supporting and only the convective layer and interstitial liquid contributes to the retained gas pressure).
- Assuming the headspace gas concentrations are proportional to retained gas concentrations may be a conservative assumption.
- Available void fraction information for sludge tanks with at least 1 m of supernatant is not sufficient for the creation of a distribution for this tank configuration. The default void fraction derived for saltcake/salt slurry tanks with 1 m of liquid is assumed to be conservative for this tank configuration.

³ Crystal Ball is a trademark of Decisioneering, Inc., Denver, Colorado.

⁴ Excel is a trademark of Microsoft Corporation, Redmond, Washington.

- Void fractions are considered constant in tanks that have been saltwell pumped when compared to the prepumping condition of the tank.
- Retained gas void fractions are bound by the neutral buoyancy void fraction in DSTs only.
- There is no correlation assumed between H_2 and NH_3 gas concentrations.
- The volume of waste, when less than the dish height, is assumed to be proportional to the height within the dish. When converting waste height to volume, this is conservative by overestimating the volume of waste and, therefore, overestimating the volume of retained gas when waste is contained only in the dish.
- The volume of waste, when less than the knuckle height, is assumed to be proportional to the height within the knuckle. When converting waste height to volume, this is conservative by overestimating the volume of waste and, therefore, overestimating the volume of retained gas when waste is contained only in the knuckle.

3.5 SOFTWARE USED

The calculations performed to establish the waste group assignments for are performed primarily using spreadsheets developed in Microsoft Excel 2003. These spreadsheets compile data, determine ranges of uncertainty, establish distributions to represent the uncertainty, and perform the final waste group calculations. The final spreadsheet used to perform the waste group calculations contains the Excel add-in software Crystal Ball described in Section 3.3, which performs the data sampling and handling for the Monte Carlo simulation that is used to determine the confidence level of the waste group assignment. Figure 3-1 illustrates the hierarchy of the spreadsheets and macros. Full details of each spreadsheet used to perform the data manipulation and calculations for RPP-10006, Rev. 5, are provided in the documents listed below.

Spreadsheet Verification Form Number: SVF-1407, *Spreadsheet Verification Records for Spreadsheet 'SVF-1407.xls'*

Base Software: Microsoft Excel 2003

Spreadsheet Title: SVF-1407.xls

Document: RPP-36011, *Spreadsheet Description Document for SVF-1407, Updated DST Solids Levels for RPP-10006, Rev 7*

Author: J. M. Conner

Purpose: Double-shell tank nonconvective layer depth determination

Spreadsheet Verification Form Number: SVF-1117, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006 R5 Tank Physical Data 060208.xls'*
Base Software: Microsoft Excel 2003
Spreadsheet Title: RPP-10006 R5 Tank Physical Data 060208.xls.
Document: RPP-29121, *Spreadsheet Description Document for RPP-10006 R5 Tank Physical Data 060208.xls*
Author: V. S. Anda
Purpose: Determination and compilation of the tank physical property data

Spreadsheet Verification Form Number: SVF-1118, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006 Rev 5 Data Rebuild 060306.xls'*
Base Software: Microsoft Excel 2003
Spreadsheet Title: RPP-10006 Rev 5 Data Rebuild 060306.xls.
Document: RPP-29167, *Spreadsheet Description Document for RPP-10006 Rev 5 Data Rebuild 060306.xls*
Author: V. S. Anda
Purpose: Compilation of tank property data and source of data for RPP-10006 database

Spreadsheet Verification Form Number: SVF-1123, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-5926 Rev 5 Update for BDGRE.xls'*
Base Software: Microsoft Excel 2003
Spreadsheet Title: RPP-5926 Rev 5 Update for BDGRE.xls
Document: Appendix E, *Hydrogen Generation Rates Calculations for Buoyant Displacement Gas Release Event Criteria Determinations*
Author: T. A. Hu
Purpose: Calculates HGR for tank wastes where solids were recently found

Spreadsheet Verification Form Number: SVF-1127, *Spreadsheet Verification and Release Form for Spreadsheet '!!RPP-10006R5_Waste_Groups-rev-44-060420.xls'*
Base Software: Microsoft Excel 2003
Spreadsheet Title: !!RPP-10006R5_Waste_Groups-rev-44-060420.xls
Document: RPP- 29581, *Spreadsheet Description Document For '!!RPP-10006R5_Waste_Groups-rev-44-060420.xls'*
Author: S. A. Barker
Purpose: Calculates flammable gas waste group for waste configurations

Spreadsheet Verification Form Number: SVF-1131, *Spreadsheet Verification and Release Form for Spreadsheet 'SVF 1131 BPE to Void Fraction Master R0 060221.xls'*
Base Software: Microsoft Excel 2003
Spreadsheet Title: SVF 1131 BPE to Void Fraction Master R0 060221.xls
Document: RPP-29388, *Spreadsheet Description Document For 'SVF 1131 BPE to Void Fraction Master R0 060221.xls'*
Author: S. A. Barker
Purpose: Converts BPE data to retained gas void fractions

Spreadsheet Verification Form Number: SVF-1132, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006r5 Void fraction revised data by tank - 060519.xls'*

Base Software: Microsoft Excel 2003

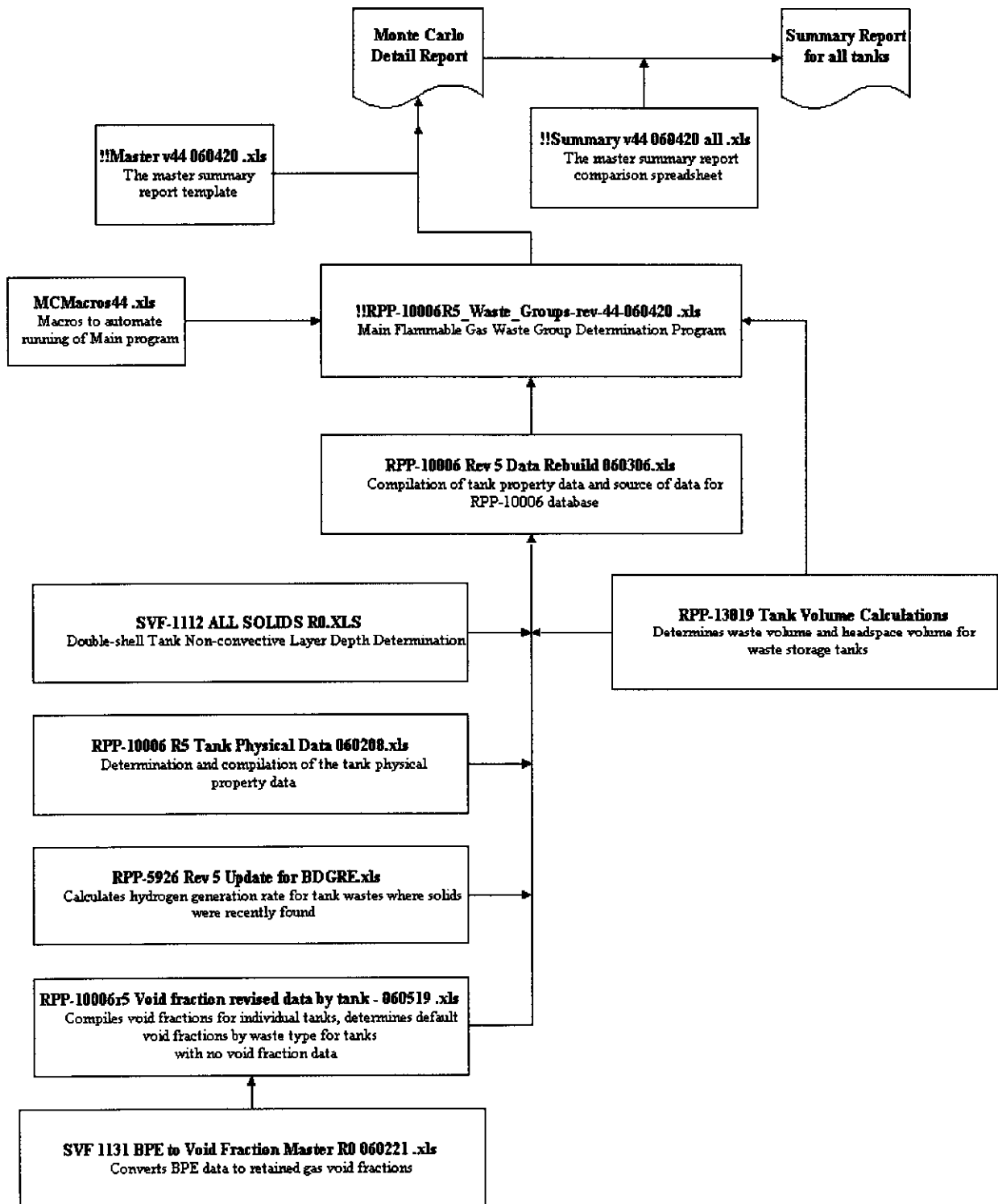
Spreadsheet Title: RPP-10006r5 Void fraction revised data by tank - 060519.xls

Document: RPP-29389, *Spreadsheet Description Document For 'RPP-10006r5 Void fraction revised data by tank - 060519.xls'*

Author: S. A. Barker

Purpose: Compiles void fractions for individual tanks, determines default void fractions by waste type for tanks with no void fraction data

Figure 3-1. RPP-10006, Rev. 5, Spreadsheet and Macro Hierarchy.



4.0 SOURCES OF INPUT DATA AND HIERARCHY

The *Best-Basis Inventory* (BBI) database is the preferred database for waste characterization information. This database is used whenever possible to maintain consistency between various engineering documents produced by Hanford Site contractors. For the evaluation of RPP-10006, Rev. 5, the BBI database was queried on September 21, 2005 (from RPP-5926, Rev. 5) and February 1, 2006 (for active retrieval tanks). The September 21, 2005, BBI data were used in the preparation of RPP-5926, Rev. 5. Data not available in the BBI, such as vapor data, were obtained from other sources as described below.

For this analysis, the DST non-convective waste depths and uncertainties were taken from Appendix C. The remaining updated input data are taken from RPP-5926, Rev. 7. These data are based on the BBI database queried on September 17, 2007. In cases where the required input data were not reported in RPP-5926, data were carried over from previous revisions.

A summary of the input data required for this evaluation and the primary source for that information is presented in Table 4-1. A table of the specific input data used for this evaluation is provided in Appendix H.

RPP-5926, Rev. 7 (September 17, 2007, BBI database), is the default source of new data for the waste and tank characteristic information to update the DST waste groups and analyze SST data. Data extracted from RPP-5926 include waste layer depth, waste layer density, waste temperatures, and headspace temperatures. Uncertainty information for the BBI data was obtained from RPP-7625, *Best-Basis Inventory Process Requirements*. Data pertaining to the tanks that display buoyant displacement behavior were obtained from RPP-6655 and PNNL-15238. Updates of waste characteristics for these tanks can be obtained from the BBI database. However, the time the sample was taken for analysis in relationship to the BDGRE event can affect the results of the analysis. Retained gas volumes may be reduced in BDGRE tanks following a BDGRE, where the property data can cause misleading results in a waste tank grouping evaluation. Tank dimensions are based on updated tank volume calculations presented in RPP-13019, *Determination of Hanford Waste Tank Volumes*.

For characterization information that is not included in the BBI database, or for information with values that are uncertain, the information is expressed as distributions. Yield stress data for six tanks (DSTs 241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, 241-SY-103, and 241-SY-101 [premitigation]) was based on in-situ ball rheometer testing (RPP-6655). The distribution established for this data is shown in Appendix F.

Table 4-1. Data Source Summary Table. (1 sheet)

Variable	Variable type	Primary source of information
Total nonconvective waste depth	Distribution	Appendix C
Saturated nonconvective waste depth	Distribution	Appendix C
Total waste depth	Distribution	Appendix C
Crust depth	Distribution	Appendix C
Nonconvective waste density	Distribution	Appendix B
Convective waste density	Distribution	Appendix B
Nonconvective waste average temperature	Single point value	RPP-5926
Tank headspace average temperature	Single point value	RPP-5926
Tank dimensions	Single point values	RPP-13019
DST OSD design limit	Single point value	OSD-T-151-00007
SST OSD design limit	Single point value	OSD-T-151-00013
Void fraction or maximum saturated solids void fraction	Distribution	Appendix D
Nonconvective waste yield stress	Distribution	Appendix F
Retained gas ratio CH ₄	Distribution	Appendix G
Retained gas ratio N ₂ O	Distribution	Appendix G
Retained gas composition N ₂	Distribution	Appendix G
Retained gas composition NH ₃	Distribution	Appendix G
Hydrogen generation rate in nonconvective waste	Distribution	RPP-5926

Notes:

OSD-T-151-00007, 2007, *Operating Specifications for the Double-Shell Storage Tanks*, Rev. 1.

OSD-T-151-00013, 2006, *Operating Specifications for Single-Shell Waste Storage Tanks*, Rev. 1.

RPP-5926, 2005, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 5.

RPP-5926, 2007, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 7.

RPP-13019, 2003, *Determination of Hanford Waste Tank Volumes*, Rev. 0.

DST = double-shell tank.

SST = single-shell tank.

Gas composition and void fraction data are not in the BBI database. Gas composition data distributions are based on RGS results and can be found in Appendix G. The void fraction distributions were completely redone in Revision 5 of RPP-10006. The revised BPE model void fractions are based on previously unused data (RPP-15488, *Investigation of Tank Void Fraction Using Liquid Level Response to Atmospheric Pressure Changes*) for all tanks with Enraf-Nonius Series 854 level gauges (Enraf) surface level measurements in 2000 (see Appendix D). Information from Appendix D and Appendix H includes the results of a statistical evaluation that generates a distribution for the void fraction and retained gas composition for tanks where no data is available. For tanks where gas composition data is available, the RGS measured gas compositions are used. For tanks with acceptable void fraction measurements, such as VFI data or good BPE data, the void fraction used in this evaluation is the measured value.

Individual tank HGRs are taken from RPP-5926, Rev. 5 (for unchanged tanks) and Rev. 7 (for updated tanks). Because the data set is limited, it is assumed that a triangular distribution adequately describes the true distribution. Determination of HGR distribution ranges is documented in Appendix E.

Some distributions are constrained to be sure that the sampled properties are in the range of expected values and also so that nonphysical conditions are not selected by the Monte Carlo sampler. There are two types of constraints used in this model: limits on property ranges and dynamically calculated controls on range values or interactions. The limits on property ranges for each distribution are listed in Appendix H. The constraints and dynamic controls are listed in Table 4-2.

Table 4-2. Monte Carlo Model Dynamic Constraints.

Variable	Constraint
Total waste depth	Constrained to tank operating limit
Total nonconvective waste depth	Constrained to total waste depth
Saturated nonconvective waste depth	Constrained to always be less than or equal to "total nonconvective waste depth"
Convective waste depth	Calculated by difference
Crust depth	No dynamic constraint
Convective waste density	No dynamic constraint
Nonconvective waste density offset	Set as the difference between the mean convective waste density and the mean nonconvective waste density with a standard deviation equal to the nonconvective waste density standard deviation.
Nonconvective waste density	Constrained to be greater than the convective waste density as it is set equal to the sum of the convective waste density and the nonconvective waste density offset.
Void fraction or maximum saturated solids void fraction	No dynamic constraint for SSTs. For DSTs the void fraction is dynamically limited to the α_{NB} void fraction.
Nonconvective waste yield stress	No dynamic constraint
Retained gas ratio CH_4	No dynamic constraint
Retained gas ratio N_2O	No dynamic constraint
Retained gas composition N_2	No dynamic constraint
Retained gas composition NH_3	No dynamic constraint
Hydrogen generation rate in nonconvective waste	No dynamic constraint

Notes:

DST = double-shell tank.
SST = single-shell tank.

In order to reflect the inter-dependency between convective and nonconvective waste densities, a nonconvective waste density offset distribution is created. The distribution is determined by setting its mean as the difference between the mean convective waste density and the mean nonconvective waste density with a standard deviation equal to the nonconvective waste density standard deviation. The nonconvective waste density is constrained to be greater than the convective waste density by setting the nonconvective waste density equal to the sum of the convective waste density and the nonconvective waste density offset.

The most complicated distribution is the void fraction distribution. Based on RPP-21336, *Flammable Gas Waste Group Assessment FY-2004-ENG-S-0133*, the truncation point of the void fraction distribution was changed to a distribution with a dynamic upper limit for DSTs. The buoyant GRE model reports that the retained gas void fraction in the nonconvective layer is limited by the neutral buoyancy void fraction. A simple dynamic distribution was created in Crystal Ball which calculates and then applies the limit to the void fraction distribution for each model iteration. This distribution is truncated on the upper end by the neutral buoyancy void fraction.

As the neutral buoyancy void fraction approaches the mean of the original distribution (is less than 0.1% greater than the mean when expressed as a percentage), the mean is adjusted to be equal to the neutral buoyancy void fraction (expressed in percent) minus 0.1%. This modification maintains the shape of the original distribution up to the truncation point. The modification of the distribution mean is performed for each trial in which the neutral buoyancy void fraction approaches or is less than the original distribution mean. This modification does not alter the shape of the original distribution and only affects the one trial.

5.0 RESULTS OF CALCULATIONS

An evaluation of the SSTs and DSTs at the Hanford Site has been completed using the methodology presented in Section 3.0, and the input data in Appendix H. Three conditions were evaluated for each tank:

- Base tank condition as of the selected data date ("as is" case)
- "As is" case with an addition of 10,000 gal of water (10,000-gal water addition case) (1,000-gal addition for 200-series SSTs)
- "As is" case with an addition of 500 gal of 8M caustic (500-gal caustic addition case) (not performed for SSTs).

The last two cases were performed to determine if any tanks change classification as the result of the addition of modest amounts of water or caustic. These two cases demonstrate what can happen to the tank classification during normal operations as the result of a number of water flushes over time, or if caustic is added to the water flush for water conditioning purposes. An additional constraint was placed on the tanks related to these additions, near-full tanks were not allowed to exceed the tank operating limit for waste volume.

The results of the waste group evaluations are shown in Table 5-1, which gives the breakdown of the results of the 5,000 trials for each tank, and whether the result classifies the tank as a waste group A, B, or C for the "As is" case. The results reported for tanks 241-AN-106, 241-BY-111, 241-B-202, and 241-TX-105 are based on the 50,000 trial results since the 5,000 trial results were within the range where the outcome is too close to determine the waste group based on the seed sensitivity test criteria (see Section 3.2).

5.1 WASTE GROUP ASSIGNMENTS

The methodology used in this waste classification evaluation indicates that if the tank exhibits category C behavior at the 95% confidence level or for 95% of the trials, the tank is classified as waste group C. If the tank exhibits category C behavior at less than the 95% confidence level, but exhibits combined category C and category B behavior at more than 95% confidence level, the tank is then classified as a waste group B tank. The remaining tanks, those that exhibit category A behavior for greater than 5% of the trials, are placed in the waste group A category.

Table 5-1. Determination of Waste Group Classification. (6 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for revision 7 of this document))

As is	Type	Waste type ^a	Category A (%)	Category B (%)	Category C (%)	"As is" waste category
241-AN-101*	DST	SC/SS-LIQ	0.00	1.80	98.20	C
241-AN-102*	DST	SC/SS-LIQ	0.42	19.56	80.02	B
241-AN-103*	DST	SC/SS-LIQ	26.24	54.64	19.12	A
241-AN-104*	DST	SC/SS-LIQ	59.36	11.06	29.58	A
241-AN-105*	DST	SC/SS-LIQ	70.48	8.18	21.34	A
241-AN-106* ^b	DST	SL-LIQ	0.05	3.36	96.59	C
241-AN-107*	DST	SC/SS-LIQ	0.00	0.00	100.00	C
241-AP-101*	DST	LIQ	0.00	0.00	100.00	C
241-AP-102*	DST	SL-LIQ	0.00	1.74	98.26	C
241-AP-103*	DST	SL-LIQ	0.00	0.00	100.00	C
241-AP-104*	DST	SC/SS-LIQ	0.00	0.48	99.52	C
241-AP-105*	DST	SC/SS-LIQ	0.00	30.48	69.52	B
241-AP-106*	DST	SC/SS-LIQ	0.00	0.44	99.56	C
241-AP-107*	DST	SC/SS-LIQ	0.00	0.46	99.54	C
241-AP-108*	DST	SC/SS-LIQ	0.02	41.06	58.92	B
241-AW-101*	DST	SC/SS-LIQ	14.54	21.44	64.02	A
241-AW-102*	DST	SL-LIQ	0.00	0.68	99.32	C
241-AW-103*	DST	SL-LIQ	0.00	0.00	100.00	C
241-AW-104*	DST	SC/SS-LIQ	2.68	33.86	63.46	B
241-AW-105*	DST	SL-LIQ	0.00	0.00	100.00	C
241-AW-106*	DST	SC/SS-LIQ	0.00	35.64	64.36	B
241-AY-101*	DST	SL-LIQ	0.00	0.00	100.00	C
241-AY-102*	DST	SL-LIQ	0.64	15.38	83.98	B
241-AZ-101*	DST	SL-LIQ	0.00	0.00	100.00	C
241-AZ-102*	DST	SL-LIQ	0.00	1.04	98.96	C
241-SY-101*	DST	SC/SS-LIQ	0.00	60.12	39.88	B
241-SY-102*	DST	SL-LIQ	0.00	0.00	100.00	C
241-SY-103*	DST	SC/SS-LIQ	9.72	3.12	87.16	A
241-A-101*	SST	SC/SS-NL	0.00	19.18	80.82	B
241-A-102	SST	SC/SS-NL	0	0	100	C
241-A-103	SST	SC/SS-NL	0	0	100	C
241-A-104	SST	SL-NL	0	0	100	C
241-A-105	SST	SL-NL	0	0	100	C

Table 5-1. Determination of Waste Group Classification. (6 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for revision 7 of this document))

As is	Type	Waste type ¹	Category A (%)	Category B (%)	Category C (%)	"As is" waste category
241-A-106	SST	MIX-NL	0	0	100	C
241-AX-101	SST	SC/SS-NL	0	0.16	99.84	C
241-AX-102	SST	SC/SS-NL	0	0	100	C
241-AX-103	SST	SC/SS-NL	0	0	100	C
241-AX-104*	SST	SL-NL	0	0	100	C
241-B-101	SST	SC/SS-NL	0	0.02	99.98	C
241-B-102	SST	SC/SS-NL	0	0	100	C
241-B-103	SST	SC/SS-NL	0	0	100	C
241-B-104	SST	SL-NL	0	3.40	96.60	C
241-B-105	SST	SC/SS-NL	0	0.44	99.56	C
241-B-106	SST	SL-NL	0	0	100	C
241-B-107	SST	MIX-NL	0	1.72	98.28	C
241-B-108	SST	SC/SS-NL	0	0	100	C
241-B-109	SST	MIX-NL	0	0	100	C
241-B-110	SST	SL-NL	0	0.44	99.56	C
241-B-111	SST	SL-NL	0	0.32	99.68	C
241-B-112	SST	MIX-NL	0	0	100	C
241-B-201	SST	SL-NL	0	6.08	93.92	B
241-B-202 ^b	SST	SL-NL	0	4.60	95.40	B
241-B-203	SST	SL-NL	0	69.0	31.0	B
241-B-204	SST	SL-NL	0	67.0	33.0	B
241-BX-101	SST	SL-NL	0	0	100	C
241-BX-102*	SST	SL-NL	0	0	100	C
241-BX103*	SST	SL-NL	0	0	100	C
241-BX-104	SST	SL-NL	0	0	100	C
241-BX-105	SST	MIX-NL	0	0	100	C
241-BX-106*	SST	SC/SS-NL	0	0	100	C
241-BX-107	SST	SL-NL	0	0.02	99.98	C
241-BX-108	SST	SL-NL	0	0	100	C
241-BX-109	SST	SL-NL	0	0.04	99.96	C
241-BX-110	SST	MIX-NL	0	0	100	C
241-BX-111	SST	SC/SS-NL	0	0	100	C
241-BX-112	SST	SL-NL	0	0	100	C
241-BY-101*	SST	SC/SS-NL	0.00	17.22	82.78	B

Table 5-1. Determination of Waste Group Classification. (6 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for revision 7 of this document))

As is	Type	Waste type ^a	Category A (%)	Category B (%)	Category C (%)	"As is" waste category
241-BY-102	SST	SC/SS-NL	0	1.18	98.82	C
241-BY-103	SST	SC/SS-NL	0	34.3	65.7	B
241-BY-104	SST	SC/SS-NL	0	10.4	89.6	B
241-BY-105	SST	SC/SS-NL	0	32.3	67.7	B
241-BY-106	SST	SC/SS-NL	0	8.42	91.58	B
241-BY-107	SST	SC/SS-NL	0	1.28	98.72	C
241-BY-108	SST	SC/SS-NL	0	0.54	99.46	C
241-BY-109	SST	SC/SS-NL	0	12.8	87.2	B
241-BY-110	SST	SC/SS-NL	0	14.5	85.5	B
241-BY-111 ^b	SST	SC/SS-NL	0	4.20	95.80	C ^b
241-BY-112	SST	SC/SS-NL	0	0	100	C
241-C-101	SST	SL-NL	0	0	100	C
241-C-102*	SST	SL-NL	0	1.22	98.78	C
241-C-103*	SST	SL-NL	0	0	100	C
241-C-104	SST	SL-NL	0	0.50	99.50	C
241-C-105	SST	SL-NL	0	0	100	C
241-C-106*	SST	SL-NL	0	0	100	C
241-C-107	SST	SL-NL	0	0.36	99.64	C
241-C-108*	SST	SL-NL	0	0	100	C
241-C-109	SST	SL-NL	0	0	100	C
241-C-110	SST	SL-NL	0	0.02	99.98	C
241-C-111	SST	SL-NL	0	0	100	C
241-C-112*	SST	SL-NL	0	0.02	99.98	C
241-C-201	SST	SL-NL	0	0	100	C
241-C-202	SST	SL-NL	0	0	100	C
241-C-203	SST	SL-NL	0	0	100	C
241-C-204*	SST	SL-NL	0	0	100	C
241-S-101	SST	MIX-NL	0	0.06	99.94	C
241-S-102*	SST	MIX-NL	0	0	100	C
241-S-103	SST	SC/SS-NL	0	18.4	81.6	B
241-S-104*	SST	MIX-NL	0	15.86	84.14	B
241-S-105	SST	SC/SS-NL	0	0.88	99.12	C
241-S-106	SST	SC/SS-NL	0	0.20	99.80	C
241-S-107	SST	SL-NL	0	0	100	C

Table 5-1. Determination of Waste Group Classification. (6 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for revision 7 of this document))

As is	Type	Waste type ^a	Category A (%)	Category B (%)	Category C (%)	"As is" waste category
241-S-108	SST	SC/SS-NL	0	8.68	91.32	B
241-S-109	SST	SC/SS-NL	0	12.1	87.9	B
241-S-110	SST	SC/SS-NL	0	33.9	66.1	B
241-S-111	SST	SC/SS-NL	0	38.8	61.2	B
241-S-112*	SST	SC/SS-NL	0	0	100	C
241-SX-101	SST	MIX-NL	0	13.1	86.9	B
241-SX-102	SST	SC/SS-NL	0	11.2	88.8	B
241-SX-103	SST	SC/SS-NL	0	7.48	92.52	B
241-SX-104*	SST	MIX-NL	0	7.70	92.30	B
241-SX-105	SST	SC/SS-NL	0	2.80	97.20	C
241-SX-106	SST	SC/SS-NL	0	1.84	98.16	C
241-SX-107	SST	SL-NL	0	0	100	C
241-SX-108	SST	SL-NL	0	0	100	C
241-SX-109	SST	SC/SS-NL	0	1.44	98.56	C
241-SX-110	SST	SL-NL	0	0	100	C
241-SX-111	SST	SL-NL	0	0	100	C
241-SX-112	SST	SL-NL	0	0	100	C
241-SX-113	SST	SL-NL	0	0	100	C
241-SX-114	SST	SL-NL	0	0	100	C
241-SX-115	SST	SL-NL	0	0	100	C
241-T-101	SST	MIX-NL	0	0	100	C
241-T-102	SST	SL-NL	0	0	100	C
241-T-103	SST	SL-NL	0	0	100	C
241-T-104	SST	SL-NL	0	1.12	98.88	C
241-T-105	SST	SL-NL	0	0	100	C
241-T-106	SST	SL-NL	0	0	100	C
241-T-107	SST	SL-NL	0	0.02	99.98	C
241-T-108	SST	MIX-NL	0	0	100	C
241-T-109	SST	SC/SS-NL	0	0	100	C
241-T-110	SST	SL-NL	0	3.42	96.58	C
241-T-111	SST	SL-NL	0	8.82	91.18	B
241-T-112	SST	SL-NL	0	0	100	C
241-T-201	SST	SL-NL	0	6.82	93.18	B
241-T-202	SST	SL-NL	0	1.02	98.98	C

Table 5-1. Determination of Waste Group Classification. (6 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for revision 7 of this document))

As is	Type	Waste type ^a	Category A (%)	Category B (%)	Category C (%)	"As is" waste category
241-T-203	SST	SL-NL	0	16.4	83.6	B
241-T-204	SST	SL-NL	0	16.3	83.7	B
241-TX-101	SST	SL-NL	0	0	100	C
241-TX-102	SST	SC/SS-NL	0	0.26	99.74	C
241-TX-103	SST	SC/SS-NL	0	0	100	C
241-TX-104	SST	MIX-NL	0	0	100	C
241-TX-105 ^b	SST	SC/SS-NL	0	5.33	94.67	B ^b
241-TX-106	SST	SC/SS-NL	0	12.3	87.7	B
241-TX-107	SST	SC/SS-NL	0	0	100	C
241-TX-108	SST	SC/SS-NL	0	0.02	99.98	C
241-TX-109	SST	SL-NL	0	0.72	99.28	C
241-TX-110	SST	SC/SS-NL	0	2.26	97.74	C
241-TX-111	SST	SC/SS-NL	0	3.32	96.68	C
241-TX-112	SST	SC/SS-NL	0	63.0	37.0	B
241-TX-113	SST	SC/SS-NL	0	26.1	73.9	B
241-TX-114	SST	SC/SS-NL	0	16.7	83.3	B
241-TX-115	SST	SC/SS-NL	0	35.4	64.6	B
241-TX-116	SST	SC/SS-NL	0	6.04	93.96	B
241-TX-117	SST	SC/SS-NL	0	0.46	99.54	C
241-TX-118	SST	SC/SS-NL	0	2.88	97.12	C
241-TY-101	SST	MIX-NL	0	0.02	99.98	C
241-TY-102	SST	SC/SS-NL	0	0	100	C
241-TY-103	SST	MIX-NL	0	0.16	99.84	C
241-TY-104	SST	SL-NL	0	0	100	C
241-TY-105	SST	SL-NL	0	0	100	C
241-TY-106	SST	SL-NL	0	0	100	C
241-U-101	SST	SL-NL	0	0	100	C
241-U-102	SST	SC/SS-NL	0	17.7	82.3	B
241-U-103	SST	SC/SS-NL	0	0	100	C
241-U-104	SST	SL-NL	0	0	100	C
241-U-105	SST	SC/SS-NL	0	13.0	87.0	B
241-U-106	SST	SC/SS-NL	0	0	100	C
241-U-107	SST	SC/SS-NL	0	1.5	98.5	C
241-U-108	SST	SC/SS-NL	0	56.5	43.5	B

Table 5-1. Determination of Waste Group Classification. (6 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for revision 7 of this document))

As is	Type	Waste type ^a	Category A (%)	Category B (%)	Category C (%)	"As is" waste category
241-U-109	SST	SC/SS-NL	0	0	100	C
241-U-110	SST	SL-NL	0	0	100	C
241-U-111	SST	SC/SS-NL	0	5.34	94.66	B
241-U-112	SST	SL-NL	0	0	100	C
241-U-201	SST	SL-NL	0	0	100	C
241-U-202	SST	SL-NL	0	0	100	C
241-U-203	SST	SL-NL	0	0	100	C
241-U-204	SST	SL-NL	0	0	100	C

Notes:

^aSee Appendix A^bBased on 50,000 trials.

DST = double-shell tank.

LIQ = deep liquid layer above solids, liquid layer is at least 1 m deep.

MIX = mixed waste, less than 75 vol% sludge or saltcake.

NL = no deep liquid layer above solids, liquid layer is less than 1 m deep.

SC/SS = saltcake/salt slurry solids, at least 75 vol% saltcake/salt slurry solids.

SL = sludge solids, at least 75 vol% sludge solids.

SST = single-shell tank.

Table 5-2 lists the tanks that have a median buoyancy ratio near to or greater than 1. These tanks include the historic BDGRE tanks plus 241-AN-107, which, to date, has not exhibited BDGRE behavior. DSTs 241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101 and 241-SY-103 exhibit BDGRE behavior and are waste group A tanks.

DST 241-AN-107 has a buoyancy ratio greater than 1 due to the small differences between the convective and nonconvective layer densities. However, it has a very low gas retention rate and has not exhibited any BDGRE behavior to date. The tank does not contain sufficient retained gas to reach 100% LFL and, therefore, is classified as a waste group C tank. Historically only DSTs 241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, 241-SY-101 (pre-mitigation), and 241-SY-103 have documented cases of BDGRE behavior (RPP-6655).

Table 5-2. Indicators of Buoyant Displacement Gas Release Event Behavior.
(Based on Updated DST Input Data - Appendix H)

Tank	[%A]	[%B]	[%C]	Energy ratio (dimensionless) (95%CL)	Buoyancy ratio (dimensionless) (Median)	Buoyancy ratio (dimensionless) (95%CL)
241-AN-103	26.2	54.6	19.1	43.9	0.87	2.93
241-AN-104	59.4	11.1	29.6	42.3	1.62	7.63
241-AN-105	70.5	8.2	21.3	40.8	1.82	10.92
241-AN-107	0	0	100	46.4	1.30	10.52
241-AW-101	14.5	21.4	64.0	59.8	1.15	7.49
241-SY-103	9.7	3.1	87.2	13.8	1.88	10.47

Notes: 95% CL = 95% confidence level.
LFL = lower flammability limit.
NCL = nonconvective layer.
DST = double-shell tank.

5.1.1 Double-Shell Tanks

As shown in Table 5-3, 16 of the 28 DSTs are currently classified as waste group C tanks. For these 16 DSTs, even if 100% of the retained gas is released, the headspace flammable gas concentration will not exceed 100% LFL at a 95% confidence level. Seven DSTs, 241-AN-102, 241-AP-105, 241-AP-108, 241-AW-104, 241-AW-106, 241-AY-102, and 241-SY-101 are classified as waste group B tanks based on the model for the “as is” condition. Five DSTs, 241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101 and 241-SY-103, based on this evaluation are classified as waste group A tanks.

In all cases, up to 10,000 gal of water or 500 gal of 8M caustic, can be added to the DSTs during routine operations without affecting the waste groupings as summarized in Table 5-3.

Table 5-3. Waste Group Assignments for Double-Shell Tanks.
(Based on Updated Input Data - Appendix H data)

Tank	“As is” condition	10,000 gal H ₂ O addition	500 gal caustic addition
241-AN-101	C	C	C
241-AN-102	B	B	B
241-AN-103	A	A	A
241-AN-104	A	A	A
241-AN-105	A	A	A
241-AN-106	C	C	C
241-AN-107	C	C	C

Table 5-3. Waste Group Assignments for Double-Shell Tanks.
(Based on Updated Input Data - Appendix H data)

Tank	"As is" condition	10,000 gal H ₂ O addition	500 gal caustic addition
241-AP-101	C	C	C
241-AP-102	C	C	C
241-AP-103	C	C	C
241-AP-104	C	C	C
241-AP-105	B	B	B
241-AP-106	C	C	C
241-AP-107	C	C	C
241-AP-108	B	B	B
241-AW-101	A	A	A
241-AW-102	C	C	C
241-AW-103	C	C	C
241-AW-104	B	B	B
241-AW-105	C	C	C
241-AW-106	B	B	B
241-AY-101	C	C	C
241-AY-102	B	B	B
241-AZ-101	C	C	C
241-AZ-102	C	C	C
241-SY-101	B	B	B
241-SY-102	C	C	C
241-SY-103	A	A	A

5.1.2 Single-Shell Tanks

A review of BBI update reports shows that data for most of the SSTs has remained unchanged over the past year. For these tanks the evaluation results documented in the previous version of RPP-10006 are still valid and remain unchanged for Rev. 7. However, data for 17 of the SSTs indicate a potentially significant change. These tanks were reevaluated. Results have been incorporated into Table 5-4.

Tanks were evaluated based on the "worst case" conditions. For waste group C tanks, even if 100% of the retained gas is released, the headspace flammable gas concentration will not exceed 100% LFL at a 95% confidence level. For waste group B tanks, the headspace flammable gas concentration can reach 100% of the LFL if all of the retained gas is released at a 95% confidence level. None of the SSTs that could reach 100% LFL in the headspace have energy ratios ≥ 3 .

Table 5-4. Waste Group Assignments for Single-Shell Tanks. (2 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for Revision 7 of this document)

Tank	Type	"As is" condition	10,000 gal water addition ^a	Tank	Type	"As is" condition	10,000 gal water addition ^a
241-A-101*	SST	B	B	241-S-110	SST	B	B
241-A-102	SST	C	C	241-S-111	SST	B	B
241-A-103	SST	C	C	241-S-112*	SST	C	C
241-A-104	SST	C	C	241-SX-101	SST	B	B
241-A-105	SST	C	C	241-SX-102	SST	B	B
241-A-106	SST	C	C	241-SX-103	SST	B	B
241-AX-101	SST	C	C	241-SX-104*	SST	B	B
241-AX-102	SST	C	C	241-SX-105	SST	C	C
241-AX-103	SST	C	C	241-SX-106	SST	C	B
241-AX-104*	SST	C	C	241-SX-107	SST	C	C
241-B-101	SST	C	C	241-SX-108	SST	C	C
241-B-102	SST	C	C	241-SX-109	SST	C	C
241-B-103	SST	C	C	241-SX-110	SST	C	C
241-B-104	SST	C	C	241-SX-111	SST	C	C
241-B-105	SST	C	C	241-SX-112	SST	C	C
241-B-106	SST	C	C	241-SX-113	SST	C	C
241-B-107	SST	C	C	241-SX-114	SST	C	C
241-B-108	SST	C	C	241-SX-115	SST	C	C
241-B-109	SST	C	C	241-T-101	SST	C	C
241-B-110	SST	C	C	241-T-102	SST	C	C
241-B-111	SST	C	C	241-T-103	SST	C	C
241-B-112	SST	C	C	241-T-104	SST	C	C
241-B-201	SST	B	B	241-T-105	SST	C	C
241-B-202 ^b *	SST	C	B	241-T-106	SST	C	C
241-B-203	SST	B	B	241-T-107	SST	C	C
241-B-204	SST	B	B	241-T-108	SST	C	C
241-BX-101	SST	C	C	241-T-109	SST	C	C
241-BX-102*	SST	C	C	241-T-110	SST	C	C
241-BX-103*	SST	C	C	241-T-111	SST	B	B
241-BX-104	SST	C	C	241-T-112	SST	C	C
241-BX-105	SST	C	C	241-T-201	SST	B	B
241-BX-106*	SST	C	C	241-T-202	SST	C	C
241-BX-107	SST	C	C	241-T-203	SST	B	B
241-BX-108	SST	C	C	241-T-204	SST	B	B
241-BX-109	SST	C	C	241-TX-101	SST	C	C
241-BX-110	SST	C	C	241-TX-102	SST	C	C
241-BX-111	SST	C	C	241-TX-103	SST	C	C
241-BX-112	SST	C	C	241-TX-104	SST	C	C
241-BY-101*	SST	B	B	241-TX-105	SST	B ^b	B ^b
241-BY-102	SST	C	C	241-TX-106	SST	B	B
241-BY-103	SST	B	B	241-TX-107	SST	C	C
241-BY-104	SST	B	B	241-TX-108	SST	C	C
241-BY-105	SST	B	B	241-TX-109	SST	C	C
241-BY-106	SST	B	B	241-TX-110	SST	C	C
241-BY-107	SST	C	C	241-TX-111	SST	C	B

Table 5-4. Waste Group Assignments for Single-Shell Tanks. (2 sheets)

(Based on Input Data - Appendix H:

Asterisk (*) indicated tank re-evaluated for Revision 7 of this document)

Tank	Type	"As is" condition	10,000 gal water addition ^a	Tank	Type	"As is" condition	10,000 gal water addition ^a
241-BY-108	SST	C	C	241-TX-112	SST	B	B
241-BY-109	SST	B	B	241-TX-113	SST	B	B
241-BY-110	SST	B	B	241-TX-114	SST	B	B
241-BY-111	SST	C ^b	B ^b	241-TX-115	SST	B	B
241-BY-112	SST	C	C	241-TX-116	SST	B	B
241-C-101	SST	C	C	241-TX-117	SST	C	C
241-C-102*	SST	C	C	241-TX-118	SST	C	C
241-C-103*	SST	C	C	241-TY-101	SST	C	C
241-C-104	SST	C	C	241-TY-102	SST	C	C
241-C-105	SST	C	C	241-TY-103	SST	C	C
241-C-106*	SST	C	C	241-TY-104	SST	C	C
241-C-107	SST	C	C	241-TY-105	SST	C	C
241-C-108*	SST	C	C	241-TY-106	SST	C	C
241-C-109	SST	C	C	241-U-101	SST	C	C
241-C-110	SST	C	C	241-U-102	SST	B	B
241-C-111	SST	C	C	241-U-103	SST	C	C
241-C-112*	SST	C	C	241-U-104	SST	C	C
241-C-201	SST	C	C	241-U-105	SST	B	B
241-C-202	SST	C	C	241-U-106	SST	C	C
241-C-203	SST	C	C	241-U-107	SST	C	C
241-C-204*	SST	C	C	241-U-108	SST	B	B
241-S-101	SST	C	C	241-U-109	SST	C	C
241-S-102*	SST	C	C	241-U-110	SST	C	C
241-S-103	SST	B	B	241-U-111	SST	B	B
241-S-104*	SST	B	B	241-U-112	SST	C	C
241-S-105	SST	C	C	241-U-201	SST	C	C
241-S-106	SST	C	C	241-U-202	SST	C	C
241-S-107	SST	C	C	241-U-203	SST	C	C
241-S-108	SST	B	B	241-U-204	SST	C	C
241-S-109	SST	B	B				

Notes:

^aIn 200-series tanks only 1,000 gal of water are added.^bBased on 50,000 trials.

SST = single-shell tank.

There are three tanks that would change classification based on the addition of 10,000 gal (or 1,000 gal for 200-series tanks) of water to the tanks.

Since the current condition of SSTs precludes the formation of a waste group A tank (i.e., the tanks contain little or no supernatant) and since the tanks are inactive unless subject to retrieval, a routine annual re-evaluation of the SSTs will not occur in the future unless there is a significant change in tank properties, as identified from a review of published *Best-Basis Inventory* changes. The tanks will be re-evaluated prior to any planned retrieval activity.

This page intentionally left blank.

6.0 REFERENCES

- Best Basis Inventory*, [database accessed September 17, 2007], internet address:
<http://twins.pnl.gov/twins.htm>.
- HNF-SP-1193, 1997, *Flammable Gas Project Topical Report*, Rev. 2, DE&S Hanford Company, Inc., Richland, Washington.
- OSD-T-151-00007, 2007, *Operating Specifications for the Double-Shell Storage Tanks*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.
- OSD-T-151-00013, 2006, *Operating Specifications for Single-Shell Waste Storage Tanks*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.
- PNNL-11296, 1996, *In Situ Rheology and Gas Volume in Hanford Double-Shell Waste Tanks*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11391, 1996, *Gas Retention and Release Behavior in Hanford Single-Shell Waste Tanks*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11536, 1997, *Gas Retention and Release Behavior in Double-Shell Waste Tanks*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-13337, 2001, *Preventing Buoyant Displacement Gas Release Events in Hanford Double-Shell Waste Tanks*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-13781, 2005, *Effects of Globally Waste-Disturbing Activities on Gas Generation, Retention, and Release in Hanford Waste Tanks*, Rev. 3, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-13782, 2002, *Analysis of Induced Gas Releases During Retrieval of Hanford Double-Shell Tank Waste*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-15238, 2005, *Predicting Peak Hydrogen Concentrations from Spontaneous Gas Releases in Hanford Waste Tanks*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.
- RPP-5926, 2000, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-5926, 2005, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.

- RPP-5926, 2007, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 7, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6517, 2000, *Evaluation of Hanford High-Level Waste Tank 241-SY-101*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6655, 2000, *Data Observations on Double-Shell Flammable Gas Watchlist Tank Behavior*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-7249, 2001, *Data and Observations of Single-Shell Flammable Gas Watch List Tank Behavior*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-7625, 2007, *Best-Basis Inventory Process Requirements*, Rev. 7, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-7771, 2001, *Flammable Gas Safety Issue Resolution*, Rev. 0-A, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-10006, 2006, *Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-13019, 2003, *Determination of Hanford Waste Tank Volumes*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-15488, 2004, *Investigation of Tank Void Fraction Using Liquid Level Response to Atmospheric Pressure Changes*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-21336, 2004, *Flammable Gas Waste Group Assessment FY-2004-ENG-S-0133*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29121, 2006, *Spreadsheet Description Document for RPP-10006 R5 Tank Physical Data 060208.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29166, 2006, *Spreadsheet Description Document For SVF-1112 All Solids R0.XLS*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29167, 2006, *Spreadsheet Description Document for RPP-10006 Rev 5 Data Rebuild 060306.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29388, 2006, *Spreadsheet Description Document For 'SVF 1131 BPE to Void Fraction Master R0 060221 .xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

- RPP-29389, 2006, *Spreadsheet Description Document For 'RPP-10006r5 Void fraction revised data by tank - 060519.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29581, 2006, *Spreadsheet Description Document For '!!RPP-10006R5_Waste_Groups-rev-44-060420.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1112, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'SVF-1112 All Solids R0.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1117, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006 R5 Tank Physical Data 060208.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1118, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006 Rev 5 Data Rebuild 060306.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1123, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-5926 Rev 5 Update for BDGRE.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1127, 2006, *Spreadsheet Verification and Release Form for Spreadsheet '!!RPP-10006R5_Waste_Groups-rev-44-060420.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1131, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'SVF 1131 BPE to Void Fraction Master R0 060221.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1132, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006r5 Void fraction revised data by tank - 060519.xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- TFC-ENG-DESIGN-C-32, 2006, *Spreadsheet Development and Verification*, Rev. B-3, CH2M HILL Hanford Group, Inc., Richland, Washington.
- WHC-SD-WM-ER-526, 2001, *Evaluation of Hanford Tanks for Trapped Gas*, Rev. 1-E, CH2M HILL Hanford Group, Inc., Richland, Washington.
- WHC-SD-WM-ER-594, 1996, *Evaluation of Recommendation for Addition of Tanks to the Flammable Gas Watch List*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC-SD-WM-TI-755, 1996, *An Analysis of Parameters Describing Gas Retention/Release Behavior in Double Shell Tank Waste*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

This page intentionally left blank.

APPENDIX A

WASTE TYPE ASSIGNMENT METHODOLOGY

This page intentionally left blank.

CONTENTS

A1.0	PURPOSE.....	A-1
A2.0	GROUPING CRITERIA	A-1
A3.0	WASTE TYPES	A-2
A4.0	USE OF COMPUTER SOFTWARE	A-2
A5.0	REFERENCES	A-2

TABLES

Table A-1.	Waste Grouping Criteria, from SNL-000198, Section 2.2.2.....	A-1
------------	--	-----

LIST OF TERMS

LIQ	liquid waste form
MIX-LIQ	mixed waste form with ≥ 1 m liquid over solids
MIX-NL	mixed waste form with < 1 m liquid over solids
SC/SS	saltcake/salt slurry
SC/SS-LIQ	saltcake/salt slurry waste form with ≥ 1 m liquid over solids
SC/SS-NL	saltcake/salt slurry waste form with < 1 m liquid over solids
SL	sludge
SL-LIQ	sludge waste form with ≥ 1 m liquid over solids
SL-NL	sludge waste form with < 1 m liquid over solids
vol%	volume percent

APPENDIX A

WASTE TYPE EVALUATION

A1.0 PURPOSE

This appendix presents the tank waste type assignment methodology, based on the criteria in SNL-000198, *Flammable Gas Safety Analysis Data Review*. Updated input data for tank waste type assignment is based on the updated Best-Basis Inventory data for the tanks as reported in the most current revision of RPP-5926 unless indication of a solids layer in Appendix C suggests a more conservative waste type (i.e. tanks 241-AP-101, 241-AP-104, 241-AP-106 and 241-AP-107). The waste types presented are used in assigning variables to complete the flammable gas waste group calculations.

A2.0 GROUPING CRITERIA

SNL-000198 identifies seven possible waste forms and criteria for waste type assignment. Table A-1 presents the abbreviated waste types and definitions.

Table A-1. Waste Grouping Criteria, from
SNL-000198, Section 2.2.2.

Waste Type	Definition
LIQ	Liquid waste with less than 3 vol% solids
MIX-LIQ	Mixed sludge-saltcake waste with ≥ 1 m liquid over solids
MIX-NL	Mixed sludge-saltcake waste with < 1 m liquid over solids
SC/SS-LIQ	Saltcake/salt slurry waste with ≥ 1 m liquid over solids
SC/SS-NL	Saltcake/salt slurry waste with < 1 m liquid over solids
SL-LIQ	Sludge waste with ≥ 1 m liquid over solids
SL-NL	Sludge waste with < 1 m liquid over solids

Note:

SNL-000198, 1999, *Flammable Gas Safety Analysis Data Review*, Rev. 0,
Sandia National Laboratory, Albuquerque, New Mexico.

Liquid waste tanks have at least 97 vol% liquids. Mixed waste tanks, with or without liquid, must be more than 3 vol% solids and the solids composition must be less than 70 vol% of either type of solids. Saltcake/salt slurry tanks, with or without liquid, have greater than 3 vol% solids and at least 70 vol% saltcake and/or salt slurry. Sludge tanks, with or without liquid, have greater than 3 vol% solids and at least 70 vol% sludge.

A3.0 WASTE TYPES

Appendix H lists the assigned waste type for each tank.

A4.0 USE OF COMPUTER SOFTWARE

Waste type assignments for tanks updated in Revision 7 of this document are based on the waste phases reported in RPP-5926, Revision 7, Table A-2. For the remaining tanks input data from the spreadsheet described below remains applicable.

Spreadsheet Verification Form Number: SVF-1117, *Spreadsheet Verification & Release Form for Spreadsheet RPP-10006 R5 Tank Physical Data 060208.xls*

Base Software: Microsoft Excel¹ 2003

Spreadsheet Title: RPP-10006 R5 Tank Physical Data 060208.xls.

Document: RPP-29121, *Spreadsheet Description Document for RPP-10006 R5 Tank Physical Data 060208.xls*

Author: V. S. Anda

Purpose: Determination and compilation of the tank physical property data

A5.0 REFERENCES

RPP-5926, 2007, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 7, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-6171, 2000, *Determination Of Waste Groupings For Safety Analyses*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-29121, 2006, *Spreadsheet Description Document for RPP-10006 R5 Tank Physical Data 060208.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

SNL-000198, 1999, *Flammable Gas Safety Analysis Data Review*, Rev. 0, Sandia National Laboratory, Albuquerque, New Mexico.

SVF-1117, 2006, *Spreadsheet Verification & Release Form for Spreadsheet RPP-10006 R5 Tank Physical Data 060208.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

¹ Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

APPENDIX B

DENSITY EVALUATION

This page intentionally left blank.

CONTENTS

B1.0	INTRODUCTION	B-1
B2.0	BACKGROUND	B-1
B3.0	DENSITY METHODOLOGY AND INPUT DATA	B-2
B3.1	MONTE CARLO ANALYSIS APPROACH	B-2
B3.2	APPLIED DENSITY UNCERTAINTY	B-3
B3.3	DEVIATIONS IN MEAN DENSITY INPUTS	B-4
B4.0	DENSITY DISTRIBUTION	B-5
B4.1	RELATIVE STANDARD DEVIATION	B-5
B4.2	CONVECTIVE LAYER DENSITY DISTRIBUTION	B-5
B4.3	NONCONVECTIVE LAYER DENSITY DISTRIBUTION	B-5
B5.0	USE OF COMPUTER SOFTWARE	B-6
B6.0	RESULTS	B-7
B6.1	DENSITY DISTRIBUTIONS	B-7
B7.0	REFERENCES	B-7

TABLES

Table B-1.	Best-Basis Inventory Relative Standard Deviation (%)	
	Versus Relative Error (%).	B-4

LIST OF TERMS

BBI	Best-Basis Inventory
CL	convective layer (liquid)
DST	double-shell tank
LIQ	liquid waste form
LL	lower limit
Max	95% upper limit
Min	95% lower limit
MIX-LIQ	mixed waste form with ≥ 1 m liquid over solids
MIX-NL	mixed waste form with < 1 m liquid over solids
NCL	nonconvective layer (solid)
PNNL	Pacific Northwest National Laboratory
RSD	relative standard deviation
SC/SS	saltcake/salt slurry
SC/SS-LIQ	saltcake/salt slurry waste form with ≥ 1 m liquid over solids
SC/SS-NL	saltcake/salt slurry waste form with < 1 m liquid over solids
SL	sludge
SL-LIQ	sludge waste form with ≥ 1 m liquid over solids
SL-NL	sludge waste form with < 1 m liquid over solids
SST	single-shell tank
TWINS	Tank Waste Information Network System
UL	upper limit

APPENDIX B

DENSITY EVALUATION

B1.0 INTRODUCTION

The purpose of this appendix is to document the methodology for determining the convective layer (CL) and nonconvective layer (NCL) density uncertainties, and distributions for use in the flammable gas waste group calculations. The results are based on evaluation of the data used for RPP-10006, Revision 5. However, the resulting uncertainties and distributions are not expected to change significantly. Therefore, results for calculating the density uncertainty and distribution will be used for subsequent revisions.

B2.0 BACKGROUND

A specialty assessment of the methodology of RPP-10006, *Methodology and Calculations for the Waste Groups for Large Underground Waste Storage Tanks at the Hanford Site*, for assigning flammable gas waste groups was undertaken in 2004 and is documented in RPP-21336, *Flammable Gas Waste Group Assignment: FY2004-ENG-S-0133*.

Observation 2 from RPP-21336 stated that:

Certain physical relationships are not accounted for in the calculation that make the output distribution of the Monte Carlo analysis artificially broad and create physically impossible states.

1. Independent selection of CL and NCL densities from their distributions in the Monte Carlo analysis allows density pairs that are not physically achievable.
2. Liquid and solid densities selected from the distribution may approach each other, artificially indicating an unphysical or improbable waste state.
3. The retained gas volume for screening Waste Group C tanks is not correctly limited by varying neutral buoyancy void fraction computed from the convective and non-convective layer densities selected during the calculation.
4. Available liquid SpG [specific gravity] data suggest that the default uncertainty (5%) used in the calculation is larger than necessary.
(RPP-21336)

Items 1 and 2 relate to the calculation methodology and item 4 relates to input data for CL and NCL densities used in the analysis for calculating the flammable gas waste groups. Item 3 relates primarily to the way that void fraction is handled in the Monte Carlo analysis. Changes in methodology and input data for density as documented in Revision 5 of this document are described in this appendix. Void fraction determination is discussed in Appendix D.

B3.0 DENSITY METHODOLOGY AND INPUT DATA

B3.1 MONTE CARLO ANALYSIS APPROACH

In order to address items 1 and 2 from Observation 2 of RPP-21336 discussed above, changes were made in the waste group determination spreadsheet program to treat CL and NCL waste densities as correlated rather than treating these properties as completely independent. In order to reflect the inter-dependency between convective and nonconvective waste densities, a nonconvective waste density offset distribution was created. The distribution was determined by setting its mean as the difference between the mean convective waste density and the mean nonconvective waste density with a standard deviation equal to the nonconvective waste density standard deviation. The nonconvective waste density was constrained to be greater than the convective waste density by setting the nonconvective waste density equal to the sum of the convective waste density and the nonconvective waste density offset.

The RPP-10006, Rev. 5 database values were given for the mean, standard deviation, minimum value, and maximum value for the convective and nonconvective layer densities. A density offset distribution was created with a mean equal to the difference between the two density means. The density offset distribution was given the same standard deviation as the nonconvective layer density distribution, if one is given, if not, the convective layer density standard deviation was applied. The minimum of the offset was set to be the mean minus 2 times the standard deviation or 1 kg/m^3 , whichever is greater. The maximum of the offset was set to be the mean plus 2 times the standard deviation.

During the simulation, a value is taken from the Monte Carlo distribution for the convective layer density and from the density offset distribution. The two values are added to determine the nonconvective layer density. This relationship guarantees that the nonconvective layer density is always at least 1 kg/m^3 greater than the convective layer density.

The methodology described above considers NCL density and void fraction as independent properties. This simplification is made for ease of calculation and due to lack of adequate data to support a more rigorous correlation of NCL density and void fraction.

B3.2 APPLIED DENSITY UNCERTAINTY

In order to address item 4 from Observation 2 of RPP-21336 discussed above, a review of sample analysis data for density from the Tank Waste Information Network System (TWINS) was completed and published as part of RPP-10006, Rev. 4. The data review included sample analysis results for specific gravity, solids density, settled solids density, liquid density, density before centrifuging, density, and bulk density, with specific gravity and density assumed to be interchangeable for the purposes of the evaluation. Many data points were excluded from the data set based on criteria included in RPP-10006, Rev. 4, Appendix M. The evaluation documented in Appendix M of RPP-10006, Rev. 4, identified "...the overall uncertainty for density is about 5%. However, for liquid densities the relative error is 3.3% and the relative error for the solids densities is 6.8%." The relative error values generated for the waste types were compared to the Best-Basis Inventory (BBI) published relative standard deviation values in Table B-1.

The statement, "The BBI typically lists relative uncertainties for solid and liquid densities as 5%," was included in RPP-10006, Rev. 4, Appendix M; however, a source was not referenced. A review of RPP-7625, *Best-Basis Inventory Process Requirements*, Appendix B, "Uncertainty Estimates for the BBI," identified the density uncertainty by tank and waste phase. Table B-1 contains summarized relative standard deviation (RSD) data from RPP-7625, Table B-8. RPP-7625 references RPP-6924, *Statistical Methods for Estimating the Uncertainty in the Best Basis Inventories*, which explains the methodology used to generate the density RSDs and discusses the number of data points utilized.

Table B-1. Best-Basis Inventory Relative Standard Deviation (%)
Versus Relative Error (%).

Layer	Relative standard deviation (%) (RPP-7625, Rev. 6, Table B-8)		Relative error (%) (RPP-10006, Rev. 4)
	Single-shell tank	Double-shell tank	
Convective Layer	5.90	8.16	3.3
Nonconvective Layer	7.55	6.50	6.8

Notes:

RPP-7625, 2006, *Best-Basis Inventory Process Requirements*, Rev. 6, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10006, 2004, *Methodology and Calculations for the Waste Groups for Large Underground Waste Storage Tanks at the Hanford Site*, Rev. 4, CH2M HILL Hanford Group, Inc., Richland, Washington.

The mean CL and NCL densities used to calculate the flammable gas waste group assignments for most of the 177 tanks in this revision of RPP-10006 are taken from RPP-5926, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*. RPP-5926 calculates bulk mean densities for the liquid (CL) and solid (NCL) layers. These bulk liquid and solid densities are based on a volume weighted average of the individual waste phase densities obtained from querying the BBI Tank Density and Percent Water report for the 177 tanks.

B3.3 DEVIATIONS IN MEAN DENSITY INPUTS

RPP-5926 is the source for the mean density inputs for all the SSTs and the DSTs except for DSTs 241-AP-104, 241-AP-106 and 241-AP-107. Although RPP-5926 identifies these tanks as containing no solids, the evaluation in Appendix C of this document indicates the tanks do contain solids. As a result the RPP-5926 solids bulk density data (0 g/mL) cannot be applied for these tanks.

Tanks that do not have a bulk density reported in RPP-5926 are assigned the RPP-10006, Revision 5 value to enable completion of the calculation. The lack of a mean bulk density value signifies the related phase does not exist in the tank.

- Tank 241-AP-106 does not have a reported solid phase prior to RPP-10006, Revision 7. The assigned density and density distribution for tank 241-AP-106 solids are the same as assumed for tanks 241-AP-104 and 241-AP-107.
- A mean solids phase bulk density of 1.75 g/mL is assigned as a default value to tanks that do not have a solid phase (241-AP-101).
- For tanks that have a mean solids bulk density reported to be less than the mean liquid bulk density (i.e., 241-BX-102), the mean solid phase bulk density placeholder (1.75 g/mL) is assigned.

B4.0 DENSITY DISTRIBUTION

B4.1 RELATIVE STANDARD DEVIATION

The correct BBI RSD is determined based on the tank type, SST or DST, and waste phase, liquid or solid. The RSDs, as shown in Table B-1, are converted into standard deviations using Equations 4-1 and 4-2.

$$\text{CL standard deviation} = \text{CL mean} * \text{RSD} \quad \text{Equation 4-1}$$

$$\text{NCL standard deviation} = \text{NCL mean} * \text{RSD} \quad \text{Equation 4-2}$$

B4.2 CONVECTIVE LAYER DENSITY DISTRIBUTION

The convective layer density is assumed to be based on a normal distribution with a known variance. A 95% confidence interval is applied to obtain the minimum and the maximum values. The 95% confidence interval equations specified in RPP-6924, Section 2.3, are based on assumption of a mean based on a normal distribution with a known variance.

The minimum or 95% lower limit is calculated following Equation 4-3 with the maximum or 95% upper limit calculated following Equation 4-4. The equations are based on Equation 2-6 from RPP-6924, Section 2.3, but do not have the same variable references or multiplier order.

$$95\% \text{ Lower Limit} = \text{Mean} - (\text{Mean} * \text{RSD} * 1.96) \quad \text{Equation 4-3}$$

$$95\% \text{ Upper Limit} = \text{Mean} + (\text{Mean} * \text{RSD} * 1.96) \quad \text{Equation 4-4}$$

The distribution generated based on Equations 4-3 and 4-4 is applied unless the lower limit for the liquid density falls below 1 g/mL. Calculated minimum liquid bulk densities less than 1 g/mL are truncated at 1 g/mL to maintain a realistic distribution.

B4.3 NONCONVECTIVE LAYER DENSITY DISTRIBUTION

The nonconvective layer density is calculated as the sum of the convective layer density and a density offset as shown in Equation 4-5.

$$\text{NCL density} = \text{CL density} + \text{density offset} \quad \text{Equation 4-5}$$

The mean density offset is equal to the difference between the convective and nonconvective mean densities as shown in Equation 4-6.

$$\text{Density offset mean} = \text{NCL density mean} - \text{CL density mean} \quad \text{Equation 4-6}$$

The calculated density offset is assumed to be represented by a normal distribution with a standard deviation equal to the nonconvective layer standard deviation. Equations 4-7 and 4-8 are used to generate the minimum and maximum for the density offset distribution. The minimum density offset value is truncated at 1 kg/m^3 . Truncation of the minimum density offset ensures the convective layer density will be at least 1 kg/m^3 less than the nonconvective layer density.

$$\text{Minimum} = \text{Density offset mean} - (\text{NCL standard deviation} * 2) \quad \text{Equation 4-7}$$

$$\text{Maximum} = \text{Density offset mean} + (\text{NCL standard deviation} * 2) \quad \text{Equation 4-8}$$

The nonconvective density is calculated during performance of the Monte Carlo simulation. The nonconvective layer density for the run is calculated as the sum of the convective layer density selected for the run plus the density offset value selected for the run. Equation 4-9 provides the mathematical formula.

$$\text{NCL density} = \text{CL density (from Monte Carlo)} + \text{Density offset (from Monte Carlo)} \quad \text{Equation 4-9}$$

B5.0 USE OF COMPUTER SOFTWARE

The waste types, convective layer density means, standard deviations, minimums and maximums, as well as the nonconvective layer density means and standard deviations reported in Revision 5 of this document were compiled from the spreadsheet described below.

Spreadsheet Verification Form Number: SVF-1117, *Spreadsheet Verification & Release Form for Spreadsheet RPP-10006 R5 Tank Physical Data 060208.xls*

Base Software: Microsoft Excel¹ 2003

Spreadsheet Title: RPP-10006 R5 Tank Physical Data 060208.xls.

Document: RPP-29121, *Spreadsheet Description Document for RPP-10006 R5 Tank Physical Data 060208.xls*

Author: V. S. Anda

Purpose: Determination and compilation of the tank physical property data

¹ Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

B6.0 RESULTS

B6.1 DENSITY DISTRIBUTIONS

Convective layer and non-convective density distributions for the current revision of RPP-10006 are presented in Appendix H.

B7.0 REFERENCES

- PNNL-15238, 2005, *Predicting Peak Hydrogen Concentrations from Spontaneous Gas Releases in Hanford Waste Tanks*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.
- RPP-5926, 2007, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 7, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6924, 2000, *Statistical Methods for Estimating the Uncertainty in the Best Basis Inventories*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-7625, 2007, *Best-Basis Inventory Process Requirements*, Rev. 7, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-10006, 2006, *Methodology and Calculations for the Waste Groups for Large Underground Waste Storage Tanks at the Hanford Site*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-21336, 2004, *Flammable Gas Waste Group Assignment: FY2004-ENG-S-0133*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29121, 2006, *Spreadsheet Description Document for RPP-10006 R5 Tank Physical Data 060208.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29581, 2006, *Spreadsheet Description Document for '!!RPP-10006R5_Waste_Groups-Rev-44-060420.xls' and Associated Spreadsheets*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1117, 2006, *Spreadsheet Verification & Release Form for Spreadsheet RPP-10006 R5 Tank Physical Data 060208.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

This page intentionally left blank.

APPENDIX C

WASTE LAYER HEIGHT AND UNCERTAINTY DETERMINATION

This page intentionally left blank.

CONTENTS

C1.0	INTRODUCTION	C-1
C2.0	TOTAL WASTE HEIGHT (SURFACE LEVEL) AND UNCERTAINTY	C-1
C3.0	DOUBLE-SHELL TANK CRUST LAYER HEIGHT AND UNCERTAINTY	C-2
C4.0	INTERSTITIAL LIQUID LAYER HEIGHT AND UNCERTAINTY	C-2
C5.0	CONVECTIVE LAYER HEIGHT AND UNCERTAINTY	C-2
C6.0	NONCONVECTIVE LAYER HEIGHT AND UNCERTAINTY FOR SINGLE-SHELL TANKS	C-3
C7.0	NONCONVECTIVE LAYER HEIGHT AND UNCERTAINTY FOR DOUBLE-SHELL TANKS	C-3
C7.1	DOUBLE-SHELL TANK NONCONVECTIVE LAYER HEIGHT AND MEASUREMENT CONCERNS	C-4
C7.2	NONCONVECTIVE LAYER HEIGHT MEASUREMENT METHODS	C-4
	C7.2.1 Description of Measurement Methods	C-4
	C7.2.2 Effect of Waste Consistency on Measurement Uncertainty	C-7
	C7.2.3 Current Measurement Techniques Compared to Those Used to Develop Waste Group Methodology	C-9
C7.3	ACCOUNTING FOR BIAS BETWEEN MEASUREMENT TECHNIQUES	C-10
C7.4	UPDATING THE ANALYSIS MEANS AND MEASUREMENT UNCERTAINTIES (STANDARD DEVIATIONS)	C-10
C7.5	NONCONVECTIVE LAYER HEIGHTS AND VARIABILITIES FOR DOUBLE-SHELL TANKS	C-12
C7.6	OTHER CONSIDERATIONS	C-14
	C7.6.1 Effect of Multiple Riser Locations	C-14
	C7.6.2 Changes in Solids Levels Over Time	C-15
C7.7	SUMMARY OF DOUBLE-SHELL TANK NONCONVECTIVE LAYER CHANGES	C-16
C8.0	REFERENCES	C-17

FIGURES

Figure C-1. Ball Rheometer Data for Nonconvective Layer Interface for Double-Shell Tank 241-AN-105 (Figure 2.5 of PNNL-11296).....	C-5
Figure C-2. Sediment Level History for Selected Risers, Double-Shell Tank 241-SY-102.....	C-8
Figure C-3. Double-Shell Tank 241-AN-102 Solids History.....	C-16

TABLES

Table C-1. Comparison of Densitometer and Sludge Weight Data.	C-10
Table C-2. Summarized Statistical Data ^a	C-11
Table C-3. Nonconvective Layer Heights and Variances for Double-Shell Tank Waste Group Calculations. (2 sheets).....	C-12

LIST OF TERMS

BBI	Best Basis Inventory
BDGRE	buoyant displacement gas release event
DST	double-shell tank
Enraf	Enraf Series 854 (gauge)
ILL	interstitial liquid level
MIT	multifunction instrument tree
NCL	nonconvective layer
SACS	Surveillance Analysis Computer System
SST	single-shell tank
TWINS	Tank Waste Information Network System

This page intentionally left blank.

APPENDIX C

WASTE LAYER HEIGHT AND UNCERTAINTY DETERMINATION

C1.0 INTRODUCTION

The purpose of this appendix is to establish waste layer height estimates and uncertainties that are used in the flammable gas waste group calculations. Because of concerns about potential bias and measurement error in double-shell tank (DST) solids level measurement techniques, an extensive re-evaluation of the DST nonconvective layer (NCL) heights and height uncertainties was performed for Revision 5 of this document. This revision updates that evaluation.

The following sections describe the data used for waste layers, consisting of the total waste height, and the crust, convective layer, and NCL, as applicable. All waste layer data is assumed to be normally distributed, and will be evaluated using mean and standard deviation data.

C2.0 TOTAL WASTE HEIGHT (SURFACE LEVEL) AND UNCERTAINTY

RPP-5926, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, compiles tank waste layer and total waste volumes from the Best-Basis Inventory (BBI). DST and single-shell tank (SST) total waste heights are calculated from volumes given in this reference. The total waste volumes are converted to height by applying standard tank dimension factors documented in Appendix B of RPP-7625, *Best Basis Inventory Process Requirements*, Rev. 6 (with exceptions noted below).

Total waste height uncertainty is the same as surface level uncertainty. For tanks with free liquid surfaces, the surface level uncertainty is assumed to be 0.25 in. This is the uncertainty assumed in RPP-7625, Rev. 6, Appendix B, for tanks with an Enraf (Enraf Series 854 [gauge]) surface level measurement. This uncertainty applies to all of the DSTs except those with crusts (241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, and 241-SY-103). It is also assumed that this applies to all SSTs with free liquid (i.e., supernatant).

For the DST crust tanks, the surface level uncertainty is assumed to be the crust layer uncertainty. The crust layer uncertainty is derived from RPP-6655, *Data Observations on Double-Shell Flammable Gas Watch List Tank Behavior*, Table 5-1, which gives the crust height mean and range (e.g., 89 ± 16 cm for 241-AN-103). Standard deviations are derived from the mean and range values in SVF-1118, *Spreadsheet Verification and Release Form for Spreadsheet RPP-10006 Rev 5 Data Rebuild 060306.xls*.

SSTs with no free liquid are assumed to have a surface level uncertainty of 11.5 in. based on the surface level uncertainty (standard deviation) calculated for saltcake tanks in RPP-7625. The reference indicates a smaller uncertainty for sludge tanks, but for this analysis, 11.5 in. is assumed regardless of waste type.

C3.0 DOUBLE-SHELL TANK CRUST LAYER HEIGHT AND UNCERTAINTY

Five DSTs have crust layers: 241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, and 241-SY-103. As described above, crust layer thicknesses are taken from RPP-6655, Table 5-1, which gives the crust height mean and range (e.g., 89 ± 16 cm for 241-AN-103). Uncertainties (standard deviations) are derived from the mean and range values in SVF-1118.

C4.0 INTERSTITIAL LIQUID LAYER HEIGHT AND UNCERTAINTY

The interstitial liquid level (ILL) marks the top of the saturated (wetted) solids. It is assumed that only saturated solids can retain gas. For tanks that have little or no supernatant, the ILL may be below the average surface level. This configuration is seen in many SSTs due to saltwell pumping. Analyzing only the saturated solids volume rather than the total solids volume provides a more accurate, less conservative Waste Group calculation for tanks with this waste configuration.

ILL heights were taken from SACS (TWINS 2006) and consisted of the latest ILL measurement available for each tank as of November 22, 2005 (prior to the Revision 5 analysis). Relevant data were available for 76 SSTs (the ILL measurements for tanks 241-S-102 and 241-S-112 were not relevant since these tanks were being retrieved). A reevaluation of ILLs is not considered necessary for this revision.

If the ILL is lower than the NCL (see Section C6.0 for discussion of SST NCLs), then the ILL or saturated solids height is used in Waste Group calculations rather than the NCL height.

An uncertainty of 2.36 cm is applied to the ILL measurements. This is the maximum standard deviation for SST neutron ILL measurements reported in Appendix B of PNNL-11373, *Flammable Gas Data Evaluation Report*.

Finally, saturated NCL heights are constrained within certain limits to avoid physically impossible conditions in the Monte Carlo analysis. For DSTs, the lower limits are essentially zero (0.01 m or less may be used to avoid calculational difficulties that can be encountered with zero values).

C5.0 CONVECTIVE LAYER HEIGHT AND UNCERTAINTY

Convective layer height is not determined independently. The convective layer height can be determined from the total layer height, the NCL height, and the crust height (if any). Convective layer height uncertainty is also considered a dependent variable, and is not calculated nor used in the Waste Group calculations.

C6.0 NONCONVECTIVE LAYER HEIGHT AND UNCERTAINTY FOR SINGLE-SHELL TANKS

Although uncertainty exists in NCL height for the SSTs, it is of less concern than for the DSTs because the SSTs no longer contain supernatant liquid and solids surfaces in SSTs are typically visible via camera. SST solids volumes in the BBI have typically been established from interim stabilization evaluations (HNF-SD-RE-TI-178, *Single-Shell Tank Interim Stabilization Record*), which took into account the surface topography of the waste on completion of interim stabilization. The lack of significant supernatant in SSTs also ensures that they cannot display buoyant displacement gas release event (BDGRE) behavior in their current configuration. Hence, a rigorous evaluation of SST NCL height uncertainty was not considered warranted and was not attempted.

For the purposes of this document, mean NCL heights for SSTs have been calculated based on the BBI solids volume and the tank diameter and dish dimensions. The actual NCL heights used as input data for the analysis are provided in Appendix H.

A standard deviation of 11.5 in. was used as the uncertainty associated with SST NCL height. This uncertainty was based on the stated BBI surface level uncertainty for saltcake tanks taken from Appendix B of RPP-7625. The documented uncertainty for sludge tanks was less, so using the larger saltcake uncertainty for all SSTs is conservative.

Finally, NCL heights are constrained within certain limits to avoid physically impossible conditions in the Monte Carlo analysis. For DSTs, the lower limits are essentially zero (0.01 m or less may be used to avoid calculational difficulties that can be encountered with zero values).

C7.0 NONCONVECTIVE LAYER HEIGHT AND UNCERTAINTY FOR DOUBLE-SHELL TANKS

The waste configuration found in certain DSTs consisting of a large volume of concentrated supernatant on top of a large volume of settled solids is the only configuration in which BDGREs have actually occurred. Therefore, it is important to understand the volume of solids in the NCL, as this is a key factor in estimating the amount of gas that can be retained and released in a BDGRE. The DSTs are in active use for both routine transfers and as receiver tanks for solid wastes from SST retrievals and it is important to be able to preclude conditions that would result in BDGRE behavior. However, determining an accurate NCL height in the DSTs is inhibited by the supernatant liquid layer that prevents direct observation of the underlying solids layer.

BBI solids volumes for the DSTs are based on solids level measurements from a variety of techniques. The primary techniques used are sludge weight, zip cord, Enraf densitometer, and Enraf surface device (programmed to submerge and detect the solids interface). Core sample extrusions formed the basis for several tanks in Revision 5, several of which were not updated for this revision. The solids heights in 241-SY-101 and 241-AY-101 are partly based on gamma and neutron scans. Other techniques that have been used in the past include ball rheometer and temperature validation profiles.

C7.1 DOUBLE-SHELL TANK NONCONVECTIVE LAYER HEIGHT AND MEASUREMENT CONCERNS

Revision 5 of this document included a major reevaluation of the DST NCL data and methodology for generating tank mean and standard deviations. The current revision follows the logic established in Revision 5.

Of particular note is that Revision 5 postulated that a bias between measurement methods was present. The bias was determined to be 7 inches for zip cord and sludge weight measurements relative to Enraf densitometer measurements. That is, the sludge weight and zip cord measurements were on average about 7 inches lower than corresponding densitometer solids level measurements in the same location. Although this bias was determined on the basis of only two measurements (for 241-SY-102 and 241-AN-106), it was conservatively applied to all DST NCL measurements made by zip cord or sludge weight (for this BDGRE Waste Group evaluation only). That is, zip cord and sludge weight measurements were adjusted upward by 7 inches prior to generating tank mean and standard deviations. That methodology is continued in this revision, and the tank mean and standard deviation calculations were updated with new data.

C7.2 NONCONVECTIVE LAYER HEIGHT MEASUREMENT METHODS

C7.2.1 Description of Measurement Methods

A brief outline of solids (or NCL) measurement techniques follows.

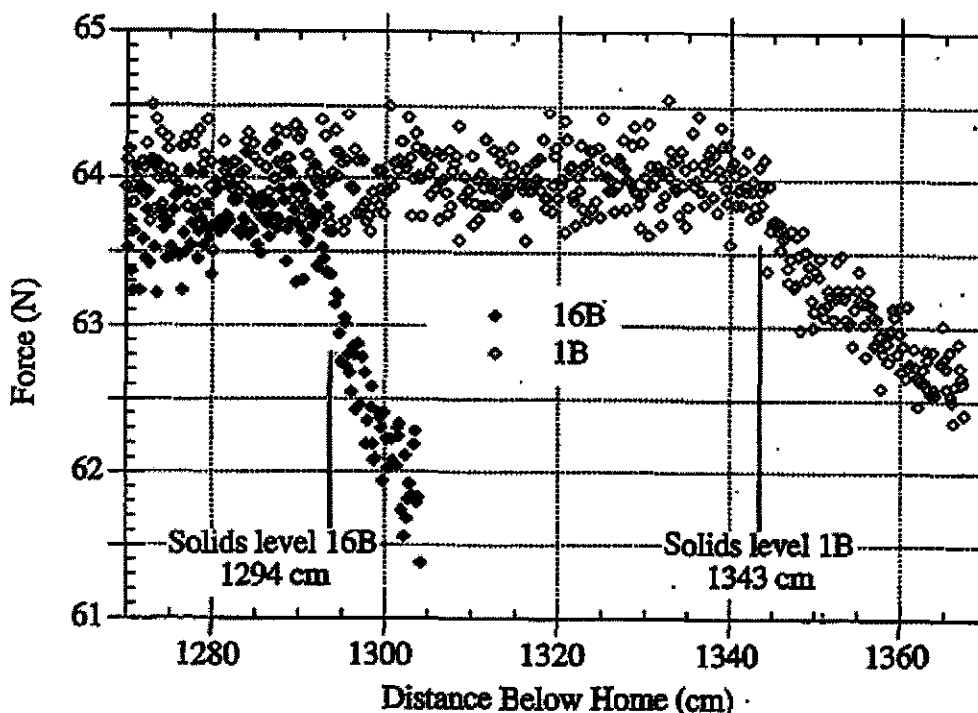
Ball rheometer: The ball rheometer is a tungsten ball (3.6 in. in diameter and 16 lb) that was deployed in the flammable gas watch list tanks. The ball was raised and lowered through the waste and the wire tension measured via a load cell. PNNL-11296, *In Situ Rheology and Gas Volume in Hanford Double-Shell Waste Tanks*, states how the interface between the convective and NCLs was detected in each tank:

... we locate the top of the non-convective layer by slowly dropping the ball from the convective region and observing the apparent weight of the ball. At the boundary the apparent weight begins to drop as the ball becomes increasingly supported by the fluid.” (p. 2.2)

The ball rheometer locates the liquid level and the top of the non-convective layer in each riser to within one ball radius (4.6 cm). Passage of the ball through the liquid is taken to be the midpoint of the decrease in tension due to increasing buoyancy as the ball submerges.” (p. 2.6)

Figure C-1 shows this graphically. As the ball is lowered at a constant rate, the wire tension is constant through the convective layer and then deflects (decreases) as more resistance is detected in the NCL.

Figure C-1. Ball Rheometer Data for Nonconvective Layer Interface for Double-Shell Tank 241-AN-105 (Figure 2.5 of PNNL-11296).



Core sample extrusions: Based on lab photos and video, sample recovery data, and field core sampling data, the level of solids can be estimated. This was considered (PNNL-15238, *Predicting Peak Hydrogen Concentrations from Spontaneous Gas Releases in Hanford Tank Wastes*, Appendix D) to be the least accurate of the three methods typically used in the flammable gas tanks (i.e., ball rheometer, temperature validation probe, or core sample extrusion).

Enraf densitometers: This device consists of a weight (displacer) on a wire, which is lowered into the supernatant. The device detects interfaces and density by measuring the weight or tension of the wire. The solids layer is determined as a decrease in wire tension by a specified amount. For the current DST 241-AN-106 application, the displacer has a mass of 239 g and the solids level is determined by a decrease in tension equivalent to 25 g. As of December 2007, densitometers are installed in DSTs 241-SY-102, 241-AN-106, 241-AY-102, and two densitometers are installed in DST 241-AN-107.

Enraf surface level devices: The standard Enraf surface level measurement device installed on many DSTs and SSTs can be reprogrammed to detect a second interface (i.e., the solids level interface). This is not a standard operation and requires a field activity (e.g., reprogramming, flushing). Solids level measurements of this type were performed in DSTs 241-SY-101 and 241-SY-102 in 1999, and in 2007 an effort has begun to upgrade the displacers (increase weight to allow them to submerge) and perform these measurements periodically in most DSTs during maintenance activities or upon request.

Temperature validation scan: The Group A flammable gas tanks (DSTs 241-AN-103, 241-AN-104, 241-AN-105, 241-AW-101, and 241-SY-103) have a multi-function instrument tree (MIT) installed with 22 thermocouples spaced out at 12 to 48 in. intervals. In addition, DST 241-AY-102 has an MIT installed, and DST 241-SY-101 has two MITs. The MIT is a hollow pipe through which other measuring devices can be deployed. A temperature validation probe has been deployed in these tanks consisting of a resistance temperature detector. The probe is in contact with the pipe which conducts heat from the waste. By pausing periodically (approximately every 4 to 6 in.) for temperature equilibration, the probe is used to measure the temperature profile. The layer interface is identified by the transition from the isothermal convective layer to the warmer NCL. This technique can only be used in tanks with MITs. Most other tanks have regular thermocouple trees with thermocouples spaced at 24 to 48 in. intervals, which is not close enough for precise determinations of convective and NCLs.

Gamma and neutron scans: Gamma detectors and neutron source/detectors have been deployed in MITs and drywells in DSTs and liquid observation wells in SSTs. The gamma scan is usually considered to be an indication of ^{137}Cs activity, the primary gamma emitter in the waste. Cesium is largely soluble, so counts are usually higher in the liquid. Thus, the solids level is estimated as the point where the gamma counts begin to decrease from the higher levels in the convective layer. If the solids interstitial liquid is higher in ^{137}Cs than the supernatant (because of transfers), or if the solids are high in radioactive $^{90}\text{Sr}/^{90}\text{Y}$, then the counts in the solids layer can be higher than in the liquid layer.

Neutron scans have been more useful for detecting interstitial liquid levels or the presence of trapped gas such as the old crust layer in DST 241-SY-101. This technique measures neutrons reflected by hydrogen (considered an indication of water), and is often not sensitive to differences between liquid and wetted solids.

Sludge weights: Sludge weight readings are described in procedure TO-040-560, *Tank Farm Sludge Level Readings*, and performed on an as-needed basis. A sludge weight with a known cable length hangs from the riser cap of selected risers. The weight is a short (approximately 2 in.) section of 1.5 or 2 in. diameter pipe weighing up to approximately 1.5 lb. Sludge weight designs can differ slightly from farm to farm. The operator attaches a measuring tape to the cable and lowers the assembly until a solid interface is detected. The sludge weight is suspended in the waste if the tank is filled, and over time salt solids can build up, resulting in reduced sensitivity. Repeated measurements can cause a localized depression in the solids. This has been observed for surface level measurements in SSTs with exposed solids.

Zip cords: A zip cord is an insulated conductive wire attached to a plummet, which is lowered into the riser from the riser flange or a fixed elevation above it (the riser adapter or top hat). "The distance from the riser to the waste surface is required for many jobs such as leak detection, sampling, level gauge installations or repairs, or tank equipment installations" (RPP-10141, *Exceptions to Ignition Source Controls*). The liquid or surface level is indicated when an electrical signal (continuity) is detected.

Zip cords are also used for solids level measurements. The solids level is calculated from the depth at which physical resistance is sensed, or the cable goes slack. Solids level zip cord measurements are typically associated with a core or grab sampling event, and are performed to determine sample points, or at the request of Engineering (e.g., in the Tank Sampling and Analysis Plan). Different plummets are used for different applications. Up until mid-2004, the plummet used for solids level determinations was a 1.5 in. section of 1.5-in.-diameter, schedule 160, steel pipe weighing approximately 0.6 lb. Since then, the zip cord weights have been the same as the sludge weights (approximately 1 to 1.5 lb).

Other techniques: Photograph and video evaluation can be used for volume determination when solids are exposed. SST solids volumes are typically estimated in this way (HNF-SD-RE-TI-178). One technique used during historical tank sluicing was solids mapping from photographs, used in coordination with pumping and liquid level measurement to allow contour mapping (RHO-ST-30, *Hanford Radioactive Tank Cleanout and Sludge Processing*). Transfer material balances can also provide useful information on the presence of solids (TFC-ENG-CHEM-D-44, *Resolution of Waste Transfer Material Balance Discrepancies*).

C7.2.2 Effect of Waste Consistency on Measurement Uncertainty

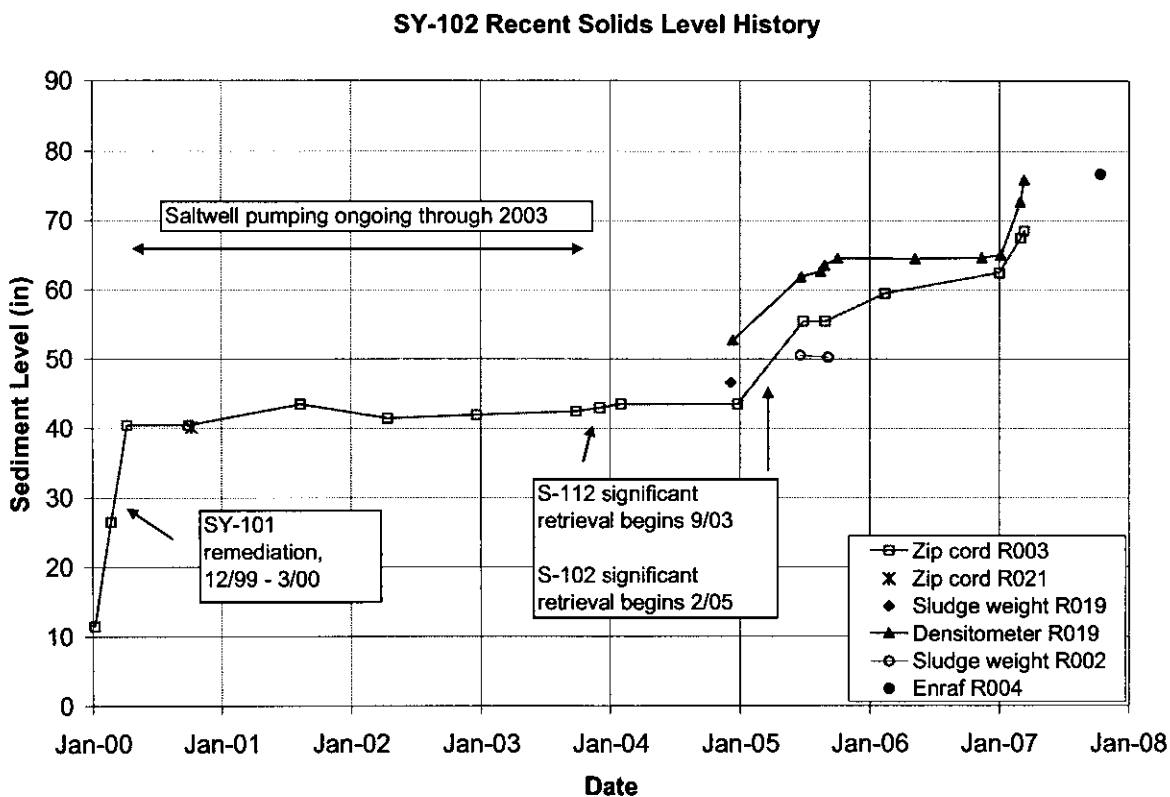
Conceptually, it seems evident that the waste consistency will affect the measurement techniques differently. For example, hard layers are difficult to retrieve with core sampling, especially push mode. Core sample recoveries have indicated solids heights could be biased low in these wastes. Measurements in tanks with hard solids layers should exhibit good agreement between physical measurement methods such as sludge weight, zip cord, densitometer, and ball rheometer, as well as indirect methods such as gamma and temperature profiles.

Loosely settled solids (waste with low-yield strength) should be easily recovered in core sampling, and thus core sampling, temperature profiles, and perhaps gamma scans should result in the most conservative measurements. Methods that rely on solids layer resistance to slow or stop a descending weight (zip cord, sludge weight, densitometer) may be biased lower in these types of solids. Automated physical measurements (densitometer and ball rheometer) should provide more consistent measurements than human techniques (sludge weights and zip cords).

Some sludge weight and zip cord data show good consistency among measurements. The 241-SY-102 zip cord measurements have been taken in riser 3 during sampling events for many years. These measurements correlate well with the process history of the tank as noted on Figure C-2. The variability observed from April 2000 to December 2004 is only 3 in., part of which can be explained as actual solids increase from saltwell pumping activities.

However, other examples of measurements in solids with low-yield stress illustrate the subjectivity inherent in zip cord and sludge weight measurements.

Figure C-2. Sediment Level History for Selected Risers, Double-Shell Tank 241-SY-102.



Sludge level measurements taken in DST 241-AN-107 in March 2003 initially indicated 85, 83, and 92 in. (rounded to the nearest inch) in risers 3, 18, and 19, respectively. The work package 2E-03-00339, *Perform 241-AN-107 Sludge Level Readings*, indicates that a measurement in riser 20 did not detect resistance until the sound of metal on metal was heard when the weight assembly contacted the tank bottom. This sludge weight felt lighter than the other three. The existence of the sludge weight on the cable was confirmed and the measurement was performed again a few days later. The field work supervisor and two operators felt a very slight difference in resistance at a cable depth corresponding to a sludge level of 82 in. During readings taken 2 months later in May 2003, the reading in riser 3 was not recorded, because the sludge weight could not be felt (i.e., there was “no restriction in the waste”) (2E-03-00794, *241-AN-107 Sludge Weight Readings*).

A zip cord measurement was taken in February 1998 in riser 20 of DST 241-AN-102. A solids level measurement of 38 in. is calculated based on the first indication of solids (ES-97-00599, *241-AN-102 Obtain Grab Samples*). A “slack cable” reading was noted at 26 in. of solids. Several subsequent readings from 2000 to 2004 have indicated 63 to 73 in. of solids at that riser. Solids precipitation from depletion of hydroxide and other mechanisms may account for some of the increase.

The DST 241-AP-108 sludge weight measurements were taken in September 2005. Results were 63, 63, and 33 in. of solids (rounded to the nearest inch) in risers 18, 19, and 20, respectively. Conversations with the field work supervisor and an operator (personal communication, Chapman 2005) indicated that the lowest measurement (riser 20) was taken first. In taking measurements in the other risers, a slight resistance was detected at cable depths corresponding to the higher measurements. It was conveyed that the same response might have been indicated at the first riser if measurements were retaken.

In summary, the measurement method is expected to make little difference if the solids layer is firm and the interface between solids and liquids is distinct. In weaker solids, differences can be substantial. The human interpretation involved in the zip cord and sludge weight measurements will inevitably lead to much larger variability than mechanical techniques such as densitometers.

C7.2.3 Current Measurement Techniques Compared to Those Used to Develop Waste Group Methodology

Prior to Revision 5, there was a concern raised that the solids level measurement methods currently used are not the same as the methods originally used in the Waste Group A flammable gas tanks. The buoyancy ratio criterion, which is a critical part of the waste group methodology, was developed by Pacific Northwest National Laboratory (PNNL-13337, *Derivation of the Buoyancy Ratio Equation From the Bubble Migration Model*) based on an extensive data set collected mostly in the historical flammable gas tanks from approximately 1995 through 2000. This data included measurements of NCL height using a variety of techniques.

The techniques used to measure the NCL height for the historical flammable gas tanks included ball rheometer, MIT temperature validation profile, and core sample extrusion. After the original analysis of NCL heights was completed, measurements were made for 241-SY-101 using MIT gamma scans (since it was remediated in 2000, 241-SY-101 is not a Group A tank). These solids level measurements for the historical flammable gas tanks are presented in PNNL-15238.

Ball rheometer, MIT temperature validation, and gamma scan techniques were not typically and are not normally used in other tanks. The typical techniques currently used for the remaining DSTs are core extrusion, sludge weight, and zip cord, Enraf densitometers, and Enraf surface devices deployed to detect a solids interface, with gamma and neutron scans being performed in 241-SY-101 and 241-AY-101.

If there is a bias between the methods typically used now (almost exclusively sludge weight, zip cord, and densitometer) and the methods originally used to define the Waste Group A flammable gas tanks, then the calculation may not be conservative. Accounting for bias is addressed in Section 7.3.

C7.3 ACCOUNTING FOR BIAS BETWEEN MEASUREMENT TECHNIQUES

RPP-10006, Revision 5 evaluated the available data by measurement technique, by tank, and by riser location. The bias adjustment recommended in Revision 5 (and implemented in this revision as well) is 7 in for zip cord and sludge weight measurements. Other techniques (e.g., Enraf densitometer) are considered equivalent to ball rheometer measurements that were the primary methodology used in the historical flammable gas tanks.

The 7-in adjustment is based on comparisons of sludge weight and densitometer measurements taken in the same riser. These measurements are shown in Table C-1. This adjustment is based on only two sets of measurements. However, the adjustment is an increase, making the calculations more conservative. If additional measurement comparisons are taken in the future, then the 7-in adjustment may be modified.

Table C-1. Comparison of Densitometer and Sludge Weight Data.

Tank	Sludge weight (in.)	Densitometer (in.)	Offset (densitometer – sludge weight)	Ratio, sludge weight/ densitometer	Comment
241-SY-102	46.6	52.7	6.1	88%	--
241-AN-106	28.125	36.81	8.7	76%	Adjusted sludge weight data based on data sheet in work package 2E-04-01498.
Average			7.4	82%	--

Note: Data from SVF-1112.

C7.4 UPDATING THE ANALYSIS MEANS AND MEASUREMENT UNCERTAINTIES (STANDARD DEVIATIONS)

After attempting to account for measurement bias (Section C7.3), measurement variability and solids topography is addressed by applying a standard deviation. This section of the document describes the calculation (or selection) of a mean and standard deviation for the DST NCLs.

In SVF-1407, *Updated DST Solids Levels For RPP-10006, Rev. 7*, the latest (2000 or later) relevant NCL measurement in each DST riser is presented. Measurements taken prior to significant tank changes (e.g., evaporator slurry transfers or retrieval transfers) are considered not relevant (and not included in the analysis). Data from the RPP-10006, Revision 5 analysis were used, along with updated measurements documented in SVF-1407.

Based on the evaluation in Section C7.3, zip cord and sludge weight data in SVF-1407 were adjusted upward by 7 in. to normalize the measurements to the techniques used for the Waste Group A tanks. Statistics (mean and standard deviation) were then calculated on the adjusted data in SVF-1407. Results (for DSTs with available data) are shown in Table C-2.

SVF-1407 also calculates a pooled standard deviation of 9.7 in. from tanks with available data. As in Revision 5, the pooled standard deviation will be applied as the variability estimate for many of the DSTs.

Table C-2. Summarized Statistical Data^a.

Tank	Adjusted Mean (in.)	Standard deviation (in.)	Count	Comment
AN-101	18.3	5.1	3	No new measurements
AN-102	62.1	13.5	5	
AN-106	101.3	n/a	1	
AN-107	89.6	4.1	6	No new measurements
AP-101 ^b	0.0	0.0	2	
AP-102	20.4	n/a	1	
AP-103	13.7	0.7	4	
AP-104	13.9	0.6	3	No new measurements
AP-105	45.3	5.4	6	
AP-106	9.6	n/a	1	
AP-107	12.4	n/a	1	No new measurements
AP-108	38.6	18.6	6	
AW-102	22.3	3.6	3	
AW-103	122.6	6.2	7	
AW-104	90.2	19.7	4	
AW-105	95.1	12.2	4	
AW-106	108.5	14.0	6	
AY-101	40.9	3.0	7	
AY-102	64.1	4.7	8	
AZ-101	23.6	5.9	5	
AZ-102	44.7	n/a	1	No new measurements
SY-101	90.8	12.0	6	
SY-102	76.1	0.7	3	
SY-103	144.9	n/a	1	
Pooled Standard Deviation ^c : 9.7 in.				

Notes: ^aThese data are based on adjusted values from SVF-1407.

^bThe 7-in adjustment is not applied to AP-101, where both zip cord measurements detected zero solids (assumption documented in SVF-1407).

^cTanks with only one measurement are not included in the pooled standard deviation calculation (documented in SVF-1407).

C7.5 NONCONVECTIVE LAYER HEIGHTS AND VARIABILITIES FOR DOUBLE-SHELL TANKS

The methodology for estimating DST mean solids levels (NCL) and standard deviations for use in the flammable gas waste group calculations is as follows:

- If the adjusted tank mean is given in Table C-2, then this result is used. The adjusted means include the conservative adjustment (7 in.) of zip cord and sludge weight data relative to other measurements. Note that the mean in Table C-2 may be the same as was used in Revision 5 (if no new measurements are available).
- If the tank is not in Table C-2, then the mean from Revision 5 is retained. There is no new information available.
- For variability, if the tank is listed in Table C-2, and there are four or more measurements, then the variability (standard deviation) listed in Table C-2 should be used (again, this may be the same as Revision 5).
- For 241-AN-103, 241-AN-104, 241-AN-105, and 241-SY-103, the variability from Revision 5 is retained. These variabilities are from PNNL-15238 and are generally more conservative than the pooled standard deviation.
- For the remaining tanks, use the pooled standard deviation of 9.7 in.

Solids heights and standard deviations for use in the Waste Group calculations, along with comments describing their derivation, are presented in Table C-3.

Table C-3. Nonconvective Layer Heights and Variances for Double-Shell Tank Waste Group Calculations. (2 sheets)

Tank	Adjusted Solids Level (in)	Standard Deviation (in)	Adjusted Level Basis	Standard Deviation Basis
241-AN-101	18.3	9.7	RPP-10006 Rev. 5 (no new data)	Pooled
241-AN-102	62.1	13.5	New information	New information
241-AN-103	149	11.4	RPP-10006 Rev. 5 (no new data)	RPP-10006 Rev. 5
241-AN-104	163	12.2	RPP-10006 Rev. 5 (no new data)	RPP-10006 Rev. 5
241-AN-105	177	6.1	RPP-10006 Rev. 5 (no new data)	RPP-10006 Rev. 5
241-AN-106	101.3	9.7	New information	Pooled
241-AN-107	89.6	4.1	RPP-10006 Rev. 5 (no new data)	RPP-10006 Rev. 5
241-AP-101	0.0	9.7	New information	Pooled

Table C-3. Nonconvective Layer Heights and Variances for Double-Shell Tank
Waste Group Calculations. (2 sheets)

Tank	Adjusted Solids Level (in)	Standard Deviation (in)	Adjusted Level Basis	Standard Deviation Basis
241-AP-102	20.4	9.7	New information	Pooled
241-AP-103	13.7	0.7	New information	New information
241-AP-104	13.9	9.7	RPP-10006 Rev. 5 (no new data)	Pooled
241-AP-105	45.3	5.4	New information	New information
241-AP-106	9.6	9.7	New information	Pooled
241-AP-107	12.4	9.7	RPP-10006 Rev. 5 (no new data)	Pooled
241-AP-108	38.6	18.6	New information	New information
241-AW-101	112	11.3	RPP-10006 Rev. 5 (no new data)	RPP-10006 Rev. 5
241-AW-102	22.3	9.7	New information	Pooled
241-AW-103	122.6	6.2	New information	New information
241-AW-104	90.2	19.7	New information	New information
241-AW-105	95.1	12.2	New information	New information
241-AW-106	108.5	14.0	New information	New information
241-AY-101	40.9	3.0	New information	New information
241-AY-102	64.1	4.7	New information	New information
241-AZ-101	23.6	5.9	New information	New information
241-AZ-102	44.7	9.7	RPP-10006 Rev. 5 (no new data)	Pooled
241-SY-101	90.8	12.0	New information	New information
241-SY-102	76.1	9.7	New information	Pooled
241-SY-103	144.9	15.6	New information	RPP-10006 Rev. 5

C7.6 OTHER CONSIDERATIONS

C7.6.1 Effect of Multiple Riser Locations

NCL heights can vary widely across the tanks. It is very important to obtain a number of readings over the tank, especially as the NCL height becomes greater and approaches levels that could be of concern for creating Waste Group A conditions (approximately 80 in. and greater). Tanks with NCL levels taken at one or two locations can give a false sense of security due to possible differences in NCL height within a given tank.

A tank that illustrates the effect of location on solids height is DST 241-AW-106. Five sludge weight readings were taken across the tank in 2004. The NCL heights ranged from 69.6 in. to 113.3 in., a difference of almost 44 in. It also appears that tanks with air lift circulators (241-AY and 241-AZ tank farms) have more uniform surfaces. Also, solids that are relatively weak, such as in DST 241-AN-107, may have a self-leveling effect, as this tank shows less variability than many other tanks.

Solids topography in SSTs is evaluated by photograph or video to document stabilization (HNF-SD-RE-TI-178) as discussed in Section C7.0. Large variations, especially from tank wall to center, are common. Reported surface level differences range from an average of 23 in. in saltcake tanks to 7 in. in sludge tanks (RPP-7625, Appendix B). SST design, wastes, and process histories (e.g., saltwell pumping) may differ substantially from the DSTs. However, there are ample reasons to consider radial variability as a significant issue in the DSTs. Radial variability has been noted in DST 241-AP-105 (HNF-SD-WM-ER-360, *Tank Characterization Report for Double-Shell Tank 241-AP-105*). Temperature cooling from the annulus is most likely the major reason for radial variability but transfer history will play a part, too. For example, transfer pumps are most often stick pumps located in the central pump pits of a DST. The elevation of the pump suction is typically low in the tank (within 10 in. of the bottom). Such configurations are likely to transfer some solids from around the region of the pump suction and leave settled solids further away undisturbed.

Most techniques except video and photographs are limited to single measurements under risers.

Another point to be made about riser locations is that the outermost tank risers in the 241-AN, 241-AW, and 241-SY tank farms are on a 28-ft radius. The tanks are 75 ft in diameter or 37.5 ft in radius. Area (and volume for a cylinder such as the DST waste configuration) is a function of the radius squared. Thus, the waste volume outside of the 28 ft radius is

$$\frac{(37.5)^2 - (28)^2}{(37.5)^2} = 44\% .$$

This means that 44% of the waste is outside of the region that can be sampled or evaluated by single point measurements under risers for tanks in these farms. However, this was also the case for the Group A tanks from which the waste group correlation was developed. The furthest risers in the 241-AP tank farm are on a 30-ft radius, and on a 34.75-ft radius for the 241-AY and 241-AZ tank farms.

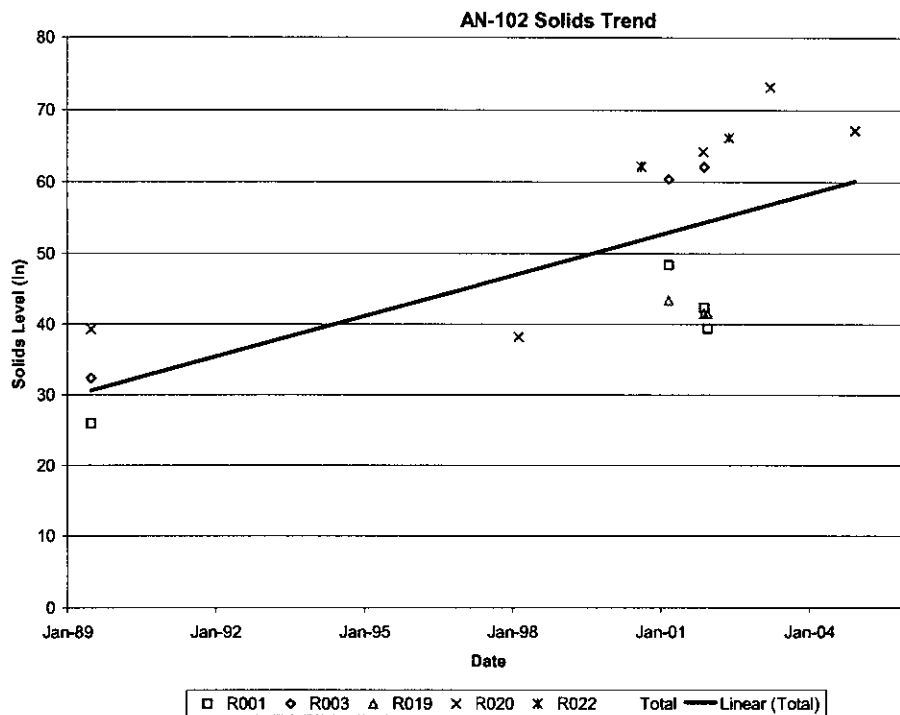
C7.6.2 Changes in Solids Levels Over Time

A number of ongoing processes may change the solids level in a tank over time, especially in tanks with concentrated waste. These include evaporation, absorption of carbon dioxide from air, chemistry (pH) changes, organic degradation reactions, temperature changes, chemical additions, and transfers. A brief description of these processes follows.

- Evaporation removes water and concentrates dissolved species. If a compound is at equilibrium between the precipitated and aqueous phases, it will precipitate and add to the solids layer.
- Absorption of carbon dioxide leads to carbonate saturation and precipitation and caustic (pH) depletion.
- pH reduction or caustic depletion leads to precipitation of pH dependent species, especially dissolved aluminum.
- Aging of organic causes precipitation of relatively insoluble species such as oxalate, along with caustic depletion.
- Waste temperature changes cause solubility changes. The DSTs are generally cooling as radionuclide concentrations decay, and lower temperatures result in reduced solubility for almost all species.
- Chemical additions may dissolve solids (e.g., aluminum compounds with caustic addition) or may cause precipitation by increasing solution ionic strength.
- Transfers may result in precipitation (e.g., mixing of wastes with differing fluoride and phosphate concentrations may lead to precipitation of the double salt natrophosphate) or could result in dissolution if different caustic concentrations are involved. Transfers may result in inadvertent pumping of solids due to waste and pump configuration. Tanks that have received transfers of evaporator slurry, either directly or from another tank, are often observed to have an increase in solids. Transfers can cause solids with trapped gas to expand or compress as the hydrostatic pressure from the supernatant layer changes.

One example of an increase of solids with time is DST 241-AN-102. The solids history back to 1989 is presented in Figure C-3. The transfer history since 1984 is very limited, consisting of a small waste transfer in 1992 and a caustic addition in 2001. The solids level was about 33 in. in 1989 and has increased to over 60 in. based on measurements taken during the last 2 years. All of the mechanisms described above, except waste transfers, have probably contributed to the increased solids.

Figure C-3. Double-Shell Tank 241-AN-102 Solids History.



Because of these issues, it is recommended that Waste Group B and C DSTs should have solids level measurements at least every 5 years.

C7.7 SUMMARY OF DOUBLE-SHELL TANK NONCONVECTIVE LAYER CHANGES

Revision 5 of this document constituted a major reevaluation of the DST solids methodology. There were no changes made for Revision 6. This revision updates the analysis with new solids level data but retains the methodology of Revision 5. The update results in revised means for more than half of the DSTs, and revised standard deviations for almost all.

Because of many factors affecting solids levels over time, it is recommended that solids level measurements be performed in DSTs at least every 5 years. Waste Group A tanks could reasonably be excluded from this recommendation, as the highest level of controls is already being applied to these tanks.

C8.0 REFERENCES

- 2E-03-00339, 2003, *Perform 241-AN-107 Sludge Level Readings*, CH2M HILL Hanford Group, Inc., Richland, Washington.
- 2E-03-00794, 2003, *241-AN-107 Sludge Weight Readings*, CH2M HILL Hanford Group, Inc., Richland, Washington.
- 2E-04-01498, 2005, *241-AN-106 Install New Enraf Densitometer*, CH2M HILL Hanford Group, Inc., Richland, Washington.
- ES-97-00599, 1998, *241-AN-102 Obtain Grab Samples*, Lockheed Martin Hanford Corporation, Richland, Washington.
- HNF-SD-RE-TI-178, 2005, *Single Shell Tank Interim Stabilization Record*, Rev. 9, CH2M HILL Hanford Group, Inc., Richland, Washington.
- HNF-SD-WM-ER-360, 1998, *Tank Characterization Report for Double-Shell Tank 241-AP-105*, Rev. 2, Lockheed Martin Hanford Corporation, Richland, Washington.
- PNNL-11296, 1996, *In Situ Rheology and Gas Volume in Hanford Double-Shell Waste Tanks*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11373, 1996, *Flammable Gas Data Evaluation Report*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-13337, 2005, *Derivation of the Buoyancy Ratio Equation From the Bubble Migration Model*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-15238, 2005, *Predicting Peak Hydrogen Concentrations from Spontaneous Gas Releases in Hanford Tank Wastes*, Pacific Northwest National Laboratory, Richland, Washington.
- RHO-ST-30, 1980, *Hanford Radioactive Tank Cleanout and Sludge Processing*, Rockwell Hanford Operations, Richland, Washington.
- RPP-5926, 2005, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6655, 2000, *Data Observations on Double-Shell Flammable Gas Watch List Tank Behavior*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-7625, 2006, *Best Basis Inventory Process Requirements*, Rev. 6, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10006, 2006, *Methodology and Calculations for Assignment of Waste Groups for Large Underground Storage Tanks at Hanford*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10141, 2003, *Exceptions to Ignition Source Controls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

S. Chapman, 2005, personal communications, S. Chapman and J. Petty with J. Jo and J. M. Conner, November.

SVF-1112, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'SVF-1112 all solids R0'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

SVF-1118, 2006, *Spreadsheet Verification and Release Form for Spreadsheet RPP-10006 Rev 5 Data Rebuild 060306.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

SVF-1407, 2007, *Updated DST Solids Levels For RPP-10006*, Rev. 7, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

Tank Waste Information Network System (TWINS), Queried February 3, 2006, [Measurements, SACS, Surface Levels], <http://twins.pnl.gov/data/datamenu.htm>.

TFC-ENG-CHEM-D-44, 2004, *Resolution of Waste Transfer Material Balance Discrepancies*, Rev. A-1, CH2M HILL Hanford Group, Inc., Richland, Washington.

TO-040-560, 2006, *Tank Farm Sludge Level Readings*, CH2M HILL Hanford Group, Inc., Richland, Washington.

APPENDIX D

DETERMINATION OF VOID FRACTION

This page intentionally left blank.

CONTENTS

D1.0	OBJECTIVE	D-1
D2.0	BACKGROUND DATA SOURCES FOR VOID FRACTION	D-1
D2.1	VOID FRACTION INSTRUMENT	D-2
D2.2	RETAINED GAS SAMPLER.....	D-2
D2.3	BAROMETRIC PRESSURE EFFECT METHOD.....	D-3
D3.0	INPUT DATA	D-4
D4.0	ASSUMPTIONS	D-8
D5.0	METHODOLOGY	D-9
D6.0	COMPUTER SOFTWARE USE AND VERIFICATION.....	D-11
D7.0	RESULTS.....	D-12
D7.1	VOID FRACTION FOR DOUBLE-SHELL TANKS 241-AN-107 AND 241-SY-101	D-13
D7.1.1	Determination of Void Fraction for Double-Shell Tank 241-AN-107	D-13
D7.1.2	Determination of Void Fraction for Double-Shell Tank 241-SY-101	D-15
D7.2	BEST VOID FRACTION DATA	D-17
D7.3	DEFAULT VOID FRACTIONS FOR EACH WASTE TYPE	D-20
D7.3.1	SC/SS-NL and MIX-NL Default Void Fraction.....	D-20
D7.3.2	SL-NL Default Void Fraction.....	D-22
D7.3.3	SC/SS-LIQ, SL-LIQ, and MIX-LIQ Default Void Fraction	D-24
D7.3.4	Liquid Waste Void Fractions.....	D-26
D7.4	VOID FRACTION ASSIGNMENT FOR 177 DOUBLE-SHELL TANKS AND SINGLE-SHELL TANKS	D-26
D8.0	CONCLUSIONS	D-28
D9.0	REFERENCES	D-29

FIGURES

Figure D-1. Example of the Correlation Between Double-Shell Tank 241-AN-107 Surface Level With the Inverse Barometric Pressure.	D-14
Figure D-2. Example of the Correlation Between Double-Shell Tank 241-SY-101 Surface Level With the Inverse Barometric Pressure.	D-16
Figure D-3. Void Fraction Regression Results for SC/SS-NL and MIX-NL Wastes.	D-22
Figure D-4. Void Fraction Regression Results for SL-NL Wastes.	D-24
Figure D-5. Void Fraction Regression Results for SC/SS-LIQ, SL-LIQ, and MIX-LIQ Wastes.	D-26

TABLES

Table D-1. dL/dP Data from Barometric Pressure Effects and Related Data to Calculate Void Fraction. (3 sheets).....	D-5
Table D-2. Results of the Barometric Pressure Effect Evaluation for Double-Shell Tank 241-AN-107.	D-13
Table D-3. Results of the Void Fraction Determination for Double-Shell Tank 241-AN-107.	D-14
Table D-4. Results of the Barometric Pressure Effect Evaluation for Double-Shell Tank 241-SY-101.	D-15
Table D-5. Results of the Void Fraction Determination for Double-Shell Tank 241-SY-101.	D-16
Table D-6. Void Fraction Data from Barometric Pressure Effect and Related Data to Calculate Void Fraction. (4 sheets).....	D-17
Table D-7. Summary of Mean Void Fraction Data for SC/SS-NL and MIX-NL Tanks With Measured Values. (2 sheets)	D-21
Table D-8. Default Void Fraction for SC/SS-NL and MIX-NL Waste with Truncated Normal Distribution.	D-22
Table D-9. Summary of Average Void Fraction Data for SL-NL Tanks With Measured Values.....	D-23
Table D-10. The Default Void Fraction for SL-NL Waste with Truncated LogNormal Distribution.	D-23
Table D-11. Summary of Average Void Fraction Data for SC/SS-LIQ Tanks With Measured Values.	D-25
Table D-12. Default Void Fraction for SC/SS-LIQ, SL-LIQ, and MIX-LIQ Waste with Truncated Normal Distribution.	D-25
Table D-13. Void Percent Distributions for Non-Default Tanks. (2 sheets).....	D-27

LIST OF TERMS

acf	actual cubic feet (gas conditions at depth at mid-point of nonconvective layer layer)
BPE	barometric pressure effect
BPE1	original BPE model
BPE2	steep slope form of the BPE model
dL/dP	change in tank level divided by corresponding change in pressure
DST	double-shell tank
Enraf	Enraf Series 854 (gauge)
MIX-LIQ	mixed waste form with ≥ 1 m liquid over solids
MIX-NL	mixed waste form with < 1 m liquid over solids
PCSACS	personal computer Surveillance Analysis Computer System
PNNL	Pacific Northwest National Laboratory
RGS	Retained Gas Sampler
SC/SS	saltcake/salt slurry
SC/SS-LIQ	saltcake/salt slurry waste form with ≥ 1 m liquid over solids
SC/SS-NL	saltcake/salt slurry waste form with < 1 m liquid over solids
SL-LIQ	sludge waste form with ≥ 1 m liquid over solids
SL-NL	sludge waste form with < 1 m liquid over solids
SST	single-shell tank
VFI	Void Fraction Instrument

This page intentionally left blank.

APPENDIX D

DETERMINATION OF VOID FRACTION

D1.0 OBJECTIVE

When analyzing tank hazards relating to flammable gas accidents it is important understand the ability of solid wastes to retain gas and then release it due to change in tank characteristics or due to outside influence or waste disturbing activities. This appendix documents the methodology used in RPP-10006, Revision 5, to develop void fraction estimates for the Hanford waste tanks. No new or revised void fraction analysis was performed for RPP-10006, Revision 7.

D2.0 BACKGROUND DATA SOURCES FOR VOID FRACTION

Void fraction data can be obtained or derived from the following available field measured data sources:

- **Void Fraction Instrument (VFI):** An average gas volume fraction may be estimated from direct measurements of the local gas volume fraction with the VFI.
- **Retained Gas Sampler (RGS):** A localized average gas volume fraction may be estimated from direct measurements of the local gas volume fraction with the RGS.
- **Barometric pressure effect (BPE) method:** An average void fraction can be computed from the correlation of the changes in waste surface level in response to barometric pressure fluctuations.
- **Surface level rise:** An increase in global average void fraction may be indicated by a rise in waste surface level such as 241-SY-101 prior to remediation (not used in this report).
- **Core sample X-ray:** Voids or gaps shown in X-rays of core samples may indicate stored gas. However, these observations are only qualitative and cannot be used to derive an average void fraction value (not used in this report).

In this report, only the data from VFI, RGS and BPE are used to obtain or derive the void fraction for waste tanks at Hanford. Void fraction is available directly from the data sources of VFI and RGS, while it requires extra data such as waste level, waste density, etc., and calculations to convert the BPE data to a void fraction. Once the void fraction data are obtained, a value is assigned to each individual tank based on the data quality preference given in Section 4.0. For those tanks that do not have field measured data, a default value is assigned based on the tank waste type (as defined in SNL-000198 and listed in Appendix H). The default values for each waste type are developed statistically based on the available measured field data. Details of VFI, RGS and BPE data measurements are given below.

D2.1 VOID FRACTION INSTRUMENT

A VFI deployment produces a relatively large number of data points in the vertical direction, but only from two risers. Each measurement is based on sampling a 367 mL waste volume (roughly a cylinder 3 in. in diameter and 3 in. long). A basic assumption made in computing the average void fraction is that data from two risers represent the entire tank. In five of the six double-shell tanks (DST) sampled with the VFI, RGS samples from two additional risers and BPE results have provided independent corroboration that this assumption is valid. Uncertainties in the average void fraction derived from VFI data range from 10 to 30% standard deviation due mainly to variability in the data (PNNL-11536, *Gas Retention and Release Behavior in Hanford Double-Shell Waste Tanks*). For these reasons the Analyst Team concluded that VFI data, with or without additional data from RGS samples, are sufficiently representative to characterize the average void fraction for a specific tank.

D2.2 RETAINED GAS SAMPLER

A single RGS gas fraction measurement is made on a 19-in. core sample segment. The void value from an RGS segment is generally as accurate as a single VFI data point, but there are far fewer RGS data. There are usually only 3 to 6 RGS measurements per tank, 1 to 3 per riser, compared to 20 to 40 VFI data points. Therefore, it is much more difficult to show that the RGS measurements are representative of the entire tank. In comparing the results for DSTs, the RGS differed from the VFI by about 50% for two tanks (DSTs 241-AN-103 and 241-AW-101) where the sparse RGS data missed the bulk of the stored gas (PNNL-11450, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-AW-101, A-101, AN-105, AN-104, and AN-103*). VFI data for single-shell tank (SST) waste are not available. For SSTs, the average gas fraction measurements with the RGS are compared with results from BPE and surface level rise analyses. Where the latter two support each other, the RGS value may differ by 50% (PNNL-11450, PNNL-11777, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-U-103, S-106, BY-101, and BY-109*). Based on these comparisons, where only RGS data are available, Pacific Northwest National Laboratory (PNNL) assigns an uncertainty of $\pm 50\%$ to the RGS value. For these reasons, the Analyst Team concluded that RGS data alone are not sufficiently representative to characterize the average void fraction in the tank waste, but can be used in determining void fraction distributions for the respective waste forms.

D2.3 BAROMETRIC PRESSURE EFFECT METHOD

The BPE method is the only means available to directly measure the total gas volume in the tank waste independent of its past history. A correlation between waste level change and barometric pressure indicates the presence of gas. However, the waste and surface level measurement system must meet the following criteria before the correlation can be used as a measurement (PNNL-11536):

- The waste must be wet. The free liquid level must be above or within a few inches of the top of the gas-retaining solids, or the solids must contain sufficient gas to float on the liquid, or both.
- The tank must contain minimal suspended hardware items (that could support the waste and interfere with level change measurements).
- The waste must not be disturbed by mixing (such as was done in DST 241-SY-101) that suspends solids and gas bubbles during the period of the BPE measurement.
- The effective pressure on the stored gas must not change significantly during the BPE measurement (e.g., by transfers).
- The precision of the waste surface level instrument must be within 0.1 in. and the level must be recorded at least daily. Because of an amplification effect that is not fully understood, the BPE method cannot be applied to interstitial liquid level data obtained with the neutron probe.

Ideally, the pressure-level correlation should be developed using data obtained from November through February when barometric pressure fluctuations are greatest. The “steep slope” BPE model, abbreviated here as the BPE2 model, uses only data obtained during these months to correlate barometric pressure and waste level. The BPE2 model also accounts for the effect of waste strength (PNNL-11693, *Estimating Retained Gas Volumes in the Hanford Tanks using Waste Level Measurements*), unlike the original, more simplified BPE model (which will be abbreviated here as the BPE1 model). In cases where only BPE1 data are available, they will be included in the development of an average void fraction value on a case-by-case basis.

The overall uncertainty in the void fraction value determined with a BPE model is driven by the uncertainty in determining both the effective pressure of the stored gas and the correlation of waste height change with barometric pressure change (the dL/dP value). The computed uncertainty varies from 20 to 50%, and void fractions determined with a BPE model can differ from RGS and VFI average void values by about the same amount.

D3.0 INPUT DATA

The void fraction assigned to each waste tank is either a field-measured value or statistically determined default value corresponding to the tank waste type. To derive the default void fraction distributions the input data of field observed void fraction data and waste property data are required. The field observed VFI and RGS void fraction data are used to assign individual tank void fractions as well as to determine the default void fraction distributions statistically. The VFI and RGS void fraction data along with the waste type data are listed in Section D7.3. The VFI and VFI with RGS results are presented in PNNL-11536, and RGS results are reported in PNNL-11373, *Flammable Gas Data Evaluation Progress Report*.

The other type of input data is dL/dP data from the BPE method along with other data such as density and waste level, which are used to derive the void fraction. Once the void fraction is derived from BPE then the void fraction values are assigned to individual data and also join the field measured void fraction data from VFI and RGS to determine the default value statistically for each waste type. Table D-1 lists the dL/dP data from BPE together with other data required to derive the void fraction. RPP-15488, *Investigation of Tank Void Fraction Using Liquid Level to Atmospheric Pressure Changes*, calculated the BPEs over the period from 1997 through 1999 using the BPE2 model for tanks with Enraf-Nonius Series 854 (ENRAF) gauges and meeting BPE requirements, and the results were reported at the Data Review Workshops in 1999.

The additional data, including density and waste level to determine the void fraction, are taken from RPP-5926, *Steady-State Flammable Gas Release Rate Calculation or Lower Flammability Evaluation for Hanford Tank Waste*, Rev. 0, which provides data from the corresponding time period as the BPE data. RPP-10006, Rev. 5, Appendix A, is used to update waste types of selected tanks based on improved tank content analysis.

In addition, the dL/dP data of tanks 241-AN-107 and 241-SY-101 has been developed using waste level and pressure data, which were queried from personal computer Surveillance Analysis Computer System (PCSACS) for various time periods from October 1, 2004, through November 1, 2005, as listed in the Section D7.1.

Table D-1. dL/dP Data from Barometric Pressure Effects and Related Data to Calculate Void Fraction. (3 sheets)

Tank name	Waste type	NCL volume (m ³)	CL volume (m ³)	NCL depth (in)	CL depth (in)	CL density (g/mL)	BPE slope (in/in Hg)
References	RPP-10006, Rev. 5, Appendix A	RPP-5926, Rev. 0, 2000					RPP-15488
241-A-101 ^a	SC/SS-NL	1,685	1,923	161.8	184.7	1.40	-0.364
241-A-103	SC/SS-NL	1,385	19	133.1	1.8	1.48	-0.013
241-A-106	MIX-NL	473	0	45.5	0.0	1.17	0.005
241-AN-101	SC/SS-LIQ	125	481	12.0	46.2	1.16	0.000
241-AN-103	SC/SS-LIQ	1,552	2,074	149.1	199.3	1.49	-0.535
241-AN-104	SC/SS-LIQ	1,700	2,286	163.3	219.6	1.40	-0.226
241-AN-105	SC/SS-LIQ	1,851	2,411	177.8	231.6	1.42	-0.180
241-AW-101	SC/SS-LIQ	1,158	3,104	111.3	298.2	1.4	-0.255
241-AW-103	SL-LIQ	1,317	613	126.6	58.9	1.02	-0.029
241-AW-104	SC/SS-LIQ	874	3,361	84.0	322.9	1.25	-0.076
241-AW-105	SL-LIQ	1,060	564	101.8	54.2	1.02	0.001
241-AW-106	SC/SS-LIQ	863	927	82.9	89.1	1.38	-0.062
241-AX-101 ^a	SC/SS-NL	1,370	1,461	131.6	140.4	1.48	-0.003
241-AX-102	SC/SS-NL	114	0	10.9	0.0	1.39	0.005
241-AX-103	SC/SS-NL	424	0	40.7	0.0	1.39	-0.002
241-AX-104	SL-NL	30	0	2.9	0.0	1.17	0.000
241-AY-101	SL-NL	409	174	39.3	16.7	1.08	-0.050
241-AY-102	SL-LIQ	799	1,556	76.7	149.5	1.09	-0.018
241-AZ-101	SL-LIQ	178	3,021	17.1	290.2	1.19	0.093
241-B-102	SC/SS-NL	106	15	17.6	1.5	1.39	-0.001
241-B-112	MIX-NL	114	11	18.4	1.1	1.27	-0.002
241-BX-101	SL-NL	159	4	22.7	0.4	1.28	-0.010
241-BX-102	SL-NL	363	0	42.4	0.0	1.17	-0.003
241-BX-103	SL-NL	235	34	30.0	3.3	1.28	-0.003
241-BX-104	SL-NL	363	11	42.4	1.1	1.29	-0.082
241-BX-105	MIX-NL	174	19	24.2	1.8	1.29	-0.002
241-BX-106	SC/SS-NL	144	0	21.3	0.0	1.17	0.001
241-BX-107	SL-NL	1,302	4	132.6	0.4	1.17	-0.088
241-BX-108	SL-NL	98	0	16.9	0.0	1.17	0.001
241-BX-109	SL-NL	731	0	77.6	0.0	1.17	-0.007
241-BX-110	MIX-NL	772	11	81.6	1.1	1.40	-0.086
241-BX-111	SC/SS-NL	609	4	66.0	0.4	1.39	-0.002

Table D-1. dL/dP Data from Barometric Pressure Effects and Related Data to Calculate Void Fraction. (3 sheets)

Tank name	Waste type	NCL volume (m ³)	CL volume (m ³)	NCL depth (in)	CL depth (in)	CL density (g/mL)	BPE slope (in/in Hg)
References	RPP-10006, Rev. 5, Appendix A	RPP-5926, Rev. 0, 2000					RPP-15488
241-BX-112	SL-NL	621	4	67.1	0.4	1.18	-0.009
241-C-103	SL-NL	450	299	50.7	28.7	1.08	-0.001
241-C-106	SL-NL	30	159	10.4	15.3	1.09	0.009
241-C-107	SL-NL	973	0	100.9	0.0	1.17	-0.004
241-S-101	MIX-NL	1,571	45	158.4	4.4	1.36	-0.171
241-S-102	SC/SS-NL	1,946	0	194.4	0.0	1.39	-0.518
241-S-103 ^b	SC/SS-NL	874	0	91.5	6.2	1.39	-0.349
241-S-106 ^b	SC/SS-NL	1,613	0	162.4	19.3	1.39	-0.316
241-S-107	SL-NL	1,370	53	139.1	5.1	1.17	-0.087
241-S-108	SC/SS-NL	1,703	0	171.1	0.0	1.39	-0.001
241-S-110	SC/SS-NL	1,476	0	149.3	0.0	1.43	0.026
241-S-111	SC/SS-NL	1,624	420	163.5	40.4	1.39	-0.437
241-SX-101	MIX-NL	1,696	0	171.1	0.0	1.50	-1.513
241-SX-103	SC/SS-NL	2,400	0	238.7	0.0	1.47	-3.103
241-SX-104	MIX-NL	1,768	0	178.0	0.0	1.39	-0.056
241-SX-105	SC/SS-NL	2,411	0	239.8	0.0	1.47	-3.181
241-SX-106	SC/SS-NL	1,223	379	125.6	36.4	1.42	-0.407
241-SY-102	SL-LIQ	333	1,984	32.0	190.6	1.18	-0.006
241-SY-103	SC/SS-LIQ	1,370	1,446	131.6	138.9	1.47	-0.196
241-T-101	MIX-NL	382	4	44.2	0.4	1.40	-0.001
241-T-102	SL-NL	72	49	14.4	4.7	1.14	0.000
241-T-107	SL-NL	655	0	70.4	0.0	1.17	-0.024
241-T-108	MIX-NL	167	0	23.5	0.0	1.40	-0.013
241-T-109	SC/SS-NL	220	0	28.6	0.0	1.39	-0.003
241-TX-101	SL-NL	318	11	38.0	1.1	1.17	-0.002
241-TX-102	SC/SS-NL	821	0	86.4	0.0	1.39	-1.570
241-TX-103	SC/SS-NL	594	0	64.6	0.0	1.39	-0.100
241-TX-104	MIX-NL	227	19	29.3	1.8	1.45	-0.002
241-TX-105	SC/SS-NL	2,305	0	228.9	0.0	1.39	-0.001
241-TX-106	SC/SS-NL	1,291	0	131.5	0.0	1.39	-0.002
241-TX-107	SC/SS-NL	132	4	20.2	0.4	1.39	-0.003
241-TX-108	SC/SS-NL	507	0	56.2	0.0	1.39	0.004
241-TX-109	SL-NL	1454	0	147.1	0.0	1.17	-0.002
241-TX-110	SC/SS-NL	1,749	0	175.5	0.0	1.39	-0.004

Table D-1. dL/dP Data from Barometric Pressure Effects and Related Data to Calculate Void Fraction. (3 sheets)

Tank name	Waste type	NCL volume (m ³)	CL volume (m ³)	NCL depth (in)	CL depth (in)	CL density (g/mL)	BPE slope (in/in Hg)
References	RPP-10006, Rev. 5, Appendix A	RPP-5926, Rev. 0, 2000					RPP-15488
241-TX-111	SC/SS-NL	1,401	0	142.0	0.0	1.39	0.001
241-TX-112	SC/SS-NL	2,457	0	243.5	0.0	1.39	-0.002
241-TX-113	SC/SS-NL	2,298	0	228.2	0.0	1.40	0.000
241-TX-114	SC/SS-NL	2,025	0	202.0	0.0	1.39	0.000
241-TX-115	SC/SS-NL	2,150	0	214.0	0.0	1.39	-0.004
241-TX-116	SC/SS-NL	2,389	0	236.9	0.0	1.39	-0.002
241-TX-117	SC/SS-NL	2,370	0	235.1	0.0	1.39	0.001
241-TX-118	SC/SS-NL	1,136	0	116.6	0.0	1.39	0.003
241-TY-101	MIX-NL	447	0	50.4	0.0	1.40	-0.004
241-TY-102	SC/SS-NL	242	0	30.7	0.0	1.39	-0.008
241-TY-103	MIX-NL	613	0	66.4	0.0	1.23	-0.014
241-TY-104	SL-NL	163	11	23.1	1.1	1.17	-0.002
241-TY-105	SL-NL	874	0	91.5	0.0	1.17	-0.009
241-TY-106	SL-NL	79	0	15.1	0.0	1.17	-0.003
241-U-103	SC/SS-NL	1,722	49	172.9	4.7	1.41	-0.334
241-U-105	SC/SS-NL	1,442	140	146.0	13.5	1.46	-0.257
241-U-106	SC/SS-NL	799	57	84.2	5.5	1.35	-0.034
241-U-107	SC/SS-NL	1,420	125	143.8	12.0	1.41	-0.267
241-U-109	SC/SS-NL	1,688	72	169.6	6.9	1.47	-0.165
241-U-110	SL-NL	704	0	75.1	0.0	1.17	0.004

Notes:

^aCL depth is 0 for calculation purposes – waste layers were inverted prior to saltwell pumping.^bCL Depth is based on information from HNF-EP-0182-130, 1999, *Waste Tank Summary Report for Month Ending 01/31/1999*, Lockheed Martin Hanford Company, Richland, Washington.RPP-5926, 2000, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.RPP-15488, 2004, *Investigation of Tank Void Fraction Using Liquid Level to Atmospheric Pressure Changes*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

BBI = Best-Basis Inventory.

BPE = barometric pressure effect.

CL = convective layer.

MIX-NL = mixed waste form with < 1 m liquid over solids

NCL = nonconvective layer.

SC/SS-LIQ = saltcake/salt slurry waste form with ≥ 1m liquid over solids.

SC/SS-NL = saltcake/salt slurry waste form with < 1m liquid over solids.

SL-LIQ = sludge waste form with ≥ 1 m liquid over solids.

SL-NL = sludge waste form with < 1 m liquid over solids.

D4.0 ASSUMPTIONS

The following assumptions pertain to the void fraction development using the dL/dP data of BPE which is calculated in the spreadsheet “SVF 1131 BPE to Void Fraction Master R0 060221 .xls” (see Section D6.0).

1. BPE sample data is normally distributed.
2. The waste surface is not fixed by waste intrusion such as risers, liquid observation wells, etc.
3. The surface of the waste was at least a small depth of liquid supernatant at the time of the level readings. The liquid pool should cover a majority of the waste surface.
4. The retained gas is subject to the pressure due to the liquid head only. The solids are self-supporting and do not contribute to the pressure on the retained gas.
5. Minimum retained gas volume is 100 ft³

The following assumptions pertain to the default void fraction development for each waste type using all available field measured void fractions, which is calculated in the spreadsheet “RPP-10006r5 Void fraction revised data by tank - 060519 .xls” (see Section D6.0.)

1. Individual tank void fractions are normally distributed.
2. The default void fractions for the various waste types are fit to specific continuous distributions based on the results of a regression performed using Crystal Ball.¹
3. The distributions selected for analysis are:
 - Normal
 - LogNormal
 - Uniform
 - Triangular
 - Gamma.

¹ Crystal Ball is a trademark of Decisioneering, Inc., Denver, Colorado.

4. The following waste types have insufficient data to be regressed by themselves. It is assumed that the following values will provide conservative default distributions for these waste types.
 - SL-LIQ (sludge waste form with ≥ 1 m liquid over solids) tanks – Use SC/SS-LIQ (saltcake/salt slurry waste form with ≥ 1 m liquid over solids) distribution results bounded by the void fraction at neutral buoyancy.
 - Liquid waste tanks – Set the void fraction to 0.
 - MIX-NL (mixed waste form with < 1 m liquid over solids) tanks – Use SC/SS-NL (saltcake/salt slurry waste form with < 1 m liquid over solids) distribution results.
 - MIX-LIQ (mixed waste form with ≥ 1 m liquid over solids) tanks – Use SC/SS-LIQ distribution results bounded by the void fraction at neutral buoyancy.
5. The following list gives the order of void fraction data preference, the most preferred data source is given first:
 - VFI + RGS
 - VFI
 - BPE
 - Derived default distribution based on waste type
 - RGS (not to be used as a basis for individual tank mean void fraction).

D5.0 METHODOLOGY

The void fraction assigned to all 177 tanks is either field-measured data or statistically determined default value of each waste type. The void fractions of several tanks (Table D-7) have been reported based on the field-measured void fraction data from the VFI or RGS project. These data can be assigned to individual tanks and can also be used to determine the default value for each waste type.

The other field measured dL/dP data is taken from the BPE method, which is the change in level corresponding to a unit change in pressure, can be used to derive the void fraction. The relationship between dL/dP and the average in-situ void fraction, (PNNL-11693) based on the ideal gas law, is given as follows:

$$\alpha = \frac{P}{L} \times \left(-\frac{dL}{dP} \right) \quad (D-1)$$

where P is the effective pressure at which the gas is stored, L is the total depth of the wetted waste.

In the calculation, the effective pressure can be calculated as follows:

$$P = P_{HS} + \rho_{CL} * g * (H_{CL} + H_{CR} + 0.5 * H_{WNCL}) \quad (D-2)$$

where P_{HS} is the pressure in the tank headspace (assumed to be 1 atmosphere), g is the gravity acceleration (9.806 m/sec^2), H_{CL} is the height of the liquid (convective) layer (m), H_{CR} is the height of the crust layer (m), and H_{WNCL} is the height of liquid saturated nonconvective layer (m).

The total in-situ gas volume V_{gas} is obtained by multiplying Equation D-1 by the total waste volume

$$V_{gas} = AP \times \left(-\frac{dL}{dP} \right) \quad (D-3)$$

where A is the tank cross-sectional area and P is the effective pressure of the gas stored.

As mentioned in Section D2.0, even though the dL/dP are developed for all tanks that currently had ENRAF data, there are additional criteria for discarding the BPE data. Tanks that have a BPE response that is positive or equal to zero are not used. Tanks that do not have a liquid surface (greater than 0.3 in. of liquid) are also not used. In addition, if the calculated retained gas volume is less than 100 ft^3 , the retained gas volume is increased to 100 ft^3 . This is a conservative assumption which allows the use of BPE data from low volume tanks. Details of individual tank data are discussed in Section D7.0.

For DSTs 241-AN-107 and 241-SY-101, the dL/dP data are determined based on the waste level and pressure. The void fraction of DST 241-AN-107 has been evaluated using PCSACS data over 12 months, from October 1, 2004, through November 1, 2005. Using the spreadsheet "BP Correlation with DB Connect .xls" template, the ENRAF and meteorological data was retrieved from PCSACS and regressed to determine the BPE correlation for the time period selected. The methodology used in the spreadsheet is a simplified version of the methodology used in RPP-15488 and verified in Software Verification Form 1002. The spreadsheet "BP Correlation with DB Connect .xls" performs the evaluation of the surface level (ENRAF data from PCSACS) response to atmospheric pressure. The user estimates an approximate slope to the surface level response, then the program uses the Excel² solver function to minimize the error to produce a statistical fit to the observed data, which returns the negative of the BPE slope.

² Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

Once all the available void fraction data are collected or derived from the field-measurements, data are assigned to the specific tank and are used to determine the default void fraction distributions based on waste type. The individual tank void fractions are selected based on the priority of data as listed in the assumptions, Section D4.0. The tank specific void fractions for those with VFI or BPE data use an uncertainty of one half of the mean void fraction.

For tanks with no void fraction measurements, a default void fraction distribution is used. The default void fraction distributions are developed based on tanks with similar waste types. All void fraction data for a specific waste type is grouped together, no matter the source. There may be multiple void fractions for selected tanks, such as a collection of BPE, RGS, and VFI data. The collected data is ordered in increasing magnitude, and fit by Crystal Ball. The distributions evaluated -- normal, lognormal, uniform and gamma -- are listed in Section D4.0. When the regression data is returned, the best fit results are used to describe the default distribution for the evaluated waste type. Waste types with sparse data, less than seven samples, are assigned a conservative default distribution from the waste types that have been successfully evaluated. Similar waste types may also be grouped together for the creation of a default distribution. For example, SC/SS-NL and MIX-NL data are grouped together. Currently, for all waste types, SC/SS-LIQ is the conservative waste type.

D6.0 COMPUTER SOFTWARE USE AND VERIFICATION

The spreadsheets used in the calculations are as follows.

Spreadsheet: "BP Correlation with DB Connect .xls"

Spreadsheet Verification Form Number: SVF-1002, *Spreadsheet Verification and Release Form for Spreadsheet 'BP Correlation with DB Connect .xls'*

Author: Barnes, D. A.

Revision: Rev. 0, released 6/27/2005

Purpose: Identify if there is a statistically significant correlation between tank level changes and atmospheric barometric pressure and quantify the effects.

Spreadsheet Name: "SVF 1131 BPE to Void Fraction Master R0 060221 .xls"

Spreadsheet Verification Form Number: SVF-1131, *Spreadsheet Verification and Release Form for Spreadsheet 'SVF 1131 BPE to Void Fraction Master R0 060221 .xls'*

Author: Barker, S. A.

Spreadsheet Description Document: RPP-29388, *Spreadsheet Description Document For 'SVF 1131 BPE to Void Fraction Master R0 060221 .xls'*

Purpose: Converts raw BPE data to void fraction.

Spreadsheet Name: "RPP-10006r5 Void fraction revised data by tank - 060519 .xls"

Spreadsheet Verification Form Number: SVF-1132, *Spreadsheet Verification and Release Form for Spreadsheet ' RPP-10006r5 Void fraction revised data by tank - 060519 .xls'*

Author: Barker, S. A.

Spreadsheet Description Document: RPP-29389, *Spreadsheet Description Document For 'RPP-10006r5 Void fraction revised data by tank - 060519 .xls'*

Purpose: Calculates the various default distributions based on waste type.

D7.0 RESULTS

The results for the calculations documented in this appendix are given as follows.

- The dL/dP data development and related void fraction calculations are performed for DSTs 241-AN-107 and 241-SY-101 based on the waste level and pressure with results in Section D7.1.
- There are 86 dL/dP data points available from the BPE study (RPP-15488). Void fractions are derived from the dL/dP data using the density, waste level, and waste type data. Only 39 void fractions are validated and adopted for use (excluding 241-AN-107 and 241-SY-101) (see Section D7.2).
- With all the available void fraction data from VFI, RGS, and BPE methods, the default value for the waste types given below are listed in Section D7.3. Default void fraction assignments are made for the waste types below using available VFI, RGS, and BPE void fraction data.
 - SC/SS-NL, and MIX-NL wastes using SC/SS-NL data
 - SL-NL wastes
 - SC/SS-LIQ, SL-LIQ, and MIX-LIQ wastes using SC/SS-LIQ data.

In addition, liquid waste is assigned a zero void fraction.

- Appendix H contains the void fraction value assigned to all 177 DSTs and SSTs.

D7.1 VOID FRACTION FOR DOUBLE-SHELL TANKS 241-AN-107 AND 241-SY-101

Void fractions are determined using waste level, pressure, and dL/dP data for DSTs 241-AN-107 and 241-SY-101. Section D.7.1.1 summarizes the evaluation for DST 241-AN-107. Section D.7.1.2 summarizes the void fraction determination for DST 241-SY-101.

D7.1.1 Determination of Void Fraction for Double-Shell Tank 241-AN-107

Figure D-1 illustrates the relationship between the surface level in DST 241-AN-107 and the inverse barometric pressure for the time period between March 14, 2005, and May 16, 2005. The R-squared value of 0.93 indicates the fit of inverse barometric pressure to surface level is significant. Note that the sign convention for this procedure is opposite the sign convention used by PNL-10821, *Screening the Hanford Tanks for Trapped Gas*. Positive slopes for the BPE correlation are valid responses to the BPE test in spreadsheet "BP Correlation with DB Connect.xls," whereas negative slopes are valid responses to the BPE test in the PNL-10821 analyses.

In the analysis of DST 241-AN-107, it was found that six of the seven periods of time met the criteria required for a good fit to BPE data. Table D-2 presents the statistics and results for this analysis. The BPE results were then entered into the spreadsheet template "SVF 1131 BPE to Void Fraction Master R0 060221.xls" to convert the results into void fraction (see Table D-3). After data analysis, an average void fraction of 0.011 was found and used to generate the void fraction distribution. The standard deviation of the good BPE data from all six periods with good fit is 0.003 and the observed void fractions ranged from 0.007 to 0.017.

Table D-2. Results of the Barometric Pressure Effect Evaluation for
Double-Shell Tank 241-AN-107.

No.	Start date	End date	Barometric pressure effect (in./in._Hg)*	Gain	Offset	Slope	r ²	Error	Max baro press change (in._Hg)
1	10/1/2004	12/10/2004	0.012	9.97	400.100	-1.289	0.981	0.007	1.37
2	12/10/2004	1/9/2005	0.009	7.44	400.099	0.819	0.925	0.001	1.46
3	3/14/2005	5/16/2005	0.015	12.79	400.019	0.619	0.930	0.004	1.03
4	5/16/2005	6/2/2005	0.012	10.00	400.152	-1.402	0.936	0.000	0.81
5	6/3/2005	7/17/2005	-0.011	-9.19	400.873	-1.005	0.972	0.001	0.62
6	7/18/2005	9/3/2005	0.014	12.01	400.152	1.234	0.987	0.001	0.71
7	9/9/2005	11/1/2005	0.022	18.68	399.866	-2.137	0.990	0.006	0.85

Note:

*For the analysis using "BP Correlation with DB Connect.xls," a positive barometric pressure effect indicates the data is valid.

Figure D-1. Example of the Correlation Between Double-Shell Tank 241-AN-107 Surface Level With the Inverse Barometric Pressure.

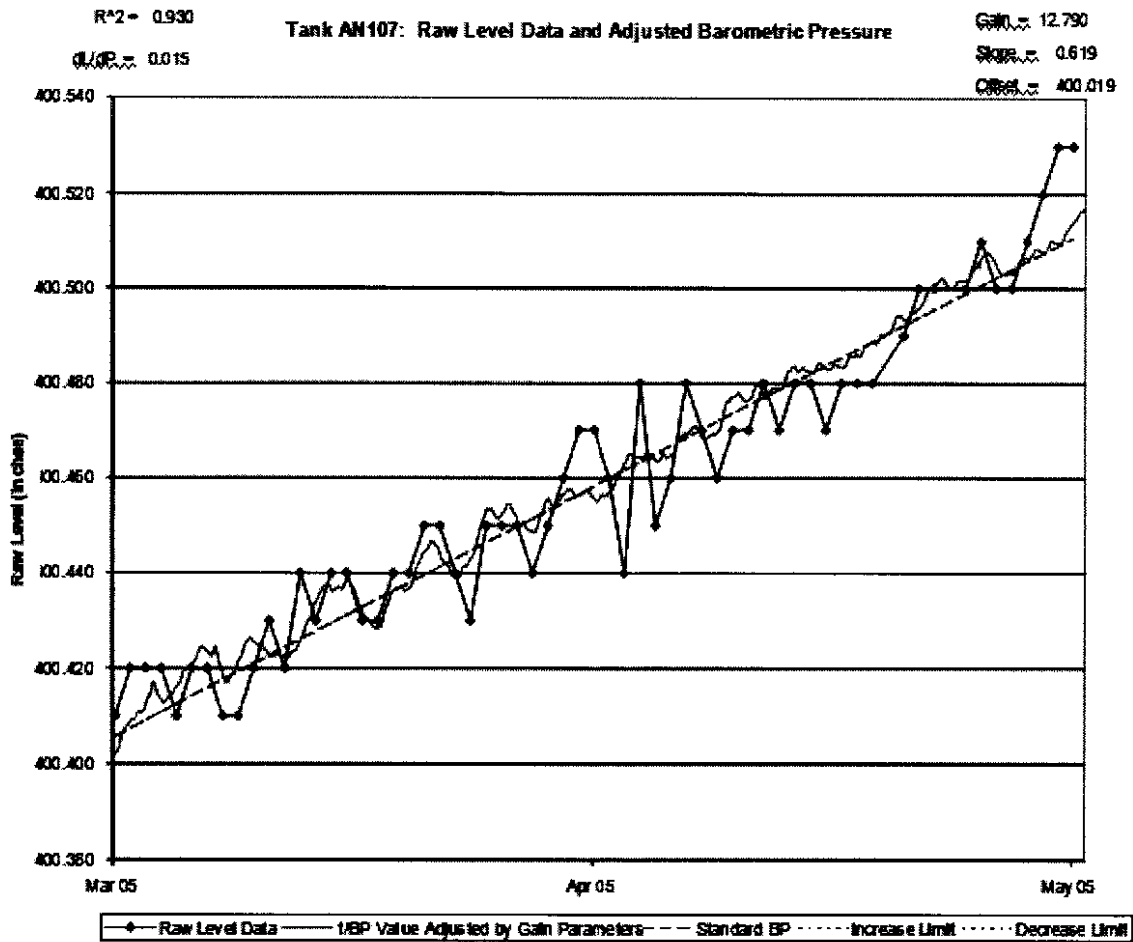


Table D-3. Results of the Void Fraction Determination for Double-Shell Tank 241-AN-107.

No.	PCSACs waste level (in.)	Liquid layer depth (in.)	Solid layer depth (in.)	Liquid density (g/mL)	Head pressure on gas (psi)	BPE slope (in./in. Hg)	Volume of retained gas (acf)	Volume of solids (ft ³)	Void fraction
1	400.4	310.58	89.82	1.43	33.06	-0.012	297	33,019	0.009
2	400.4	310.58	89.82	1.43	33.06	-0.009	223	33,019	0.007
3	400.5	310.68	89.82	1.43	33.06	-0.015	372	33,019	0.011
4	400.5	310.68	89.82	1.43	33.06	-0.012	297	33,019	0.009
5	400.6	310.78	89.82	1.43	33.07	0.011	NA	33,019	NA
6	400.6	310.78	89.82	1.43	33.07	-0.014	347	33,019	0.011
7	400.5	310.68	89.82	1.43	33.06	-0.022	545	33,019	0.017

Notes: BPE = barometric pressure effect.

PCSACS = personal computer Surveillance Analysis Computer System.

D7.1.2 Determination of Void Fraction for Double-Shell Tank 241-SY-101

Figure D-2 illustrates the relationship between the surface level in DST 241-SY-101 and the inverse barometric pressure for the time period between March 14, 2005, and May 16, 2005. The R-squared value of 0.785 indicates that the fit of inverse barometric pressure to surface level is adequate. Figure D-2 shows much more movement in the hourly barometric pressure readings than can be explained by the number of surface readings stored in PCSACS (one surface level reading per day).

In the analysis of DST 241-SY-101, it was found that 11 periods of time met the criteria required for a good fit to BPE data. Table D-4 presents the statistics and results for this analysis. Between October 2004 and September 2005, about 270 in. of liquid were added to the tank. The transfer into DST 241-SY-101 was completed on June 30, 2005. As expected, a slight decrease in void fraction was noted as the result of the increased head pressure on the retained gas due to this additional liquid.

The BPE results were then entered into the spreadsheet template "SVF 1131 BPE to Void Fraction Master R0 060221 .xls" to convert the results into void fraction. In all cases, the retained gas volume was found to be greater than 1,000 ft³. The mean void fraction for DST 241-SY-101 is 0.085 with a standard deviation of 0.024 and a range from 0.041 to 0.125. Table D-5 presents the summary of retained gas volumes and void fraction.

Table D-4. Results of the Barometric Pressure Effect Evaluation for Double-Shell Tank 241-SY-101.

No.	Start date	End date	Barometric pressure effect (in./in._hg)*	Gain	Offset	Slope	r ²	Error	Baro press change (in._Hg)
1	9/13/2005	9/29/2005	0.063	53.38	409.612	0.901	0.71	0.001	0.56
2	8/25/2005	9/13/2005	0.112	95.33	408.193	0.019	0.71	0.002	0.56
3	7/14/2005	8/13/2005	0.093	79.06	407.846	0.576	0.785	0.002	0.69
4	5/13/2005	5/29/2005	0.24	205.1	138.591	0.992	0.799	0.013	0.81
5	4/13/2005	5/12/2005	0.24	205.1	140.58	2.396	0.886	0.026	0.66
6	3/31/2005	4/12/2005	0.227	193.83	140.58	0.496	0.694	0.017	0.9
7	3/7/2005	3/30/2005	0.278	237.01	137.432	0.496	0.831	0.017	0.9
8	3/7/2005	3/4/2005	0.25	212.90	138.338	-0.72	0.904	0.000	0.38
9	1/21/2005	3/4/2005	0.25	210.63	131.157	-0.72	0.722	0.024	0.66
10	1/21/2005	1/18/2005	0.325	277.41	128.989	-2.093	0.917	0.041	1.57
11	10/17/2004	1/18/2004	0.231	196.78	131.746	-2.191	0.914	0.131	1.48

Note:

*For the analysis using "BP Correlation with DB Connect .xls," a positive barometric pressure effect indicates the data is valid.

Figure D-2. Example of the Correlation Between Double-Shell Tank 241-SY-101 Surface Level With the Inverse Barometric Pressure.

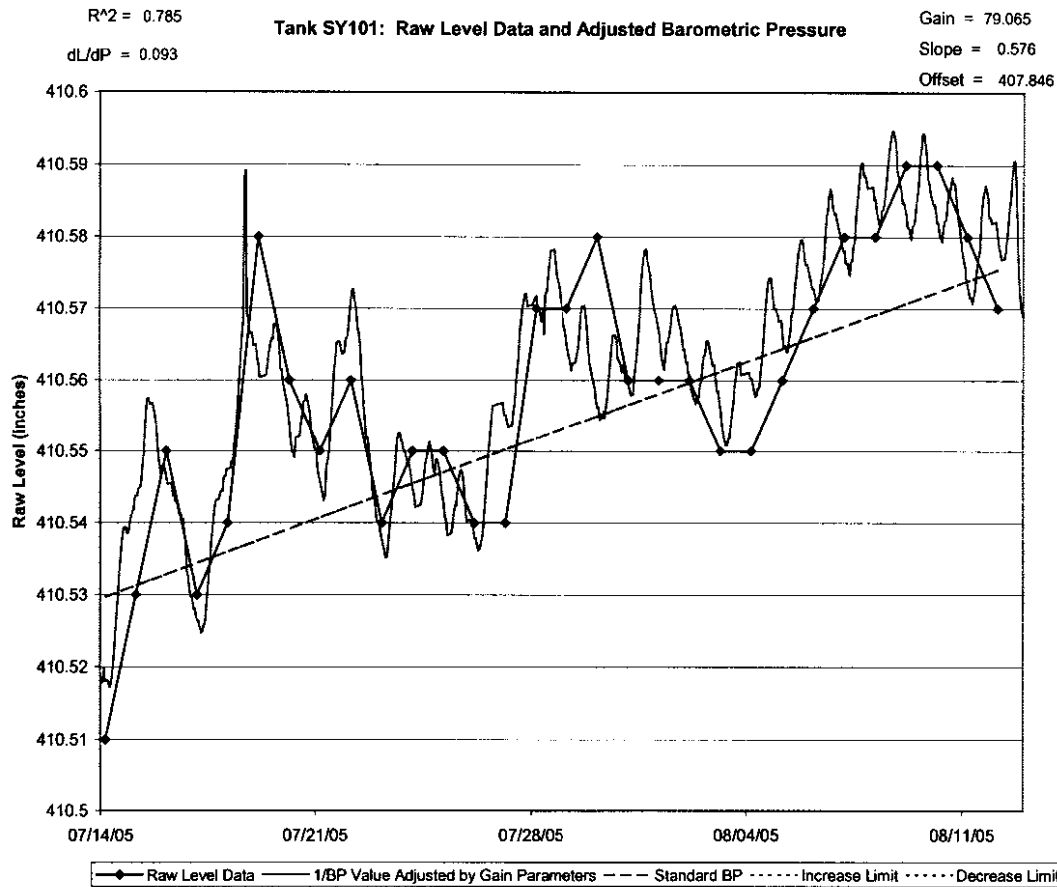


Table D-5. Results of the Void Fraction Determination for Double-Shell Tank 241-SY-101.

No.	PCSACS waste level (in)	Liquid layer depth (in)	Solid layer depth (in)	Liquid density (g/mL)	Head pressure on gas (psi)	BPE slope (in/in Hg)	Retained gas volume (acf)	Volume of solids (ft ³)	Void fraction
1	411.4	311.4	100	1.30	31.66	0.063	NA	36,833	NA
2	411.5	311.5	100	1.30	31.67	-0.112	2,659	36,833	0.072
3	410.6	310.6	100	1.30	31.63	-0.093	2,205	36,833	0.060
4	145.6	45.6	100	1.30	19.18	-0.24	3,450	36,833	0.094
5	145.6	45.6	100	1.30	19.18	-0.24	2,473	36,833	0.067
6	145.5	46	100	1.30	19.18	-0.227	3,264	36,833	0.089
7	145.6	46	100	1.30	19.18	-0.278	3,997	36,833	0.109
8	145.6	45.6	100	1.30	19.18	-0.25	3,594	36,833	0.098
9	138.3	38.3	100	1.30	18	-0.25	3,488	36,833	0.095
10	138.5	38.5	100	1.30	18.85	-0.325	4,592	36,833	0.125
11	138.5	38.5	100	1.30	18.85	-0.231	3,264	36,833	0.089

Notes: BPE = barometric pressure effect.

PCSACS = personal computer Surveillance Analysis Computer System.

D7.2 BEST VOID FRACTION DATA

The distribution of all available tank average void fraction values determined from VFI data (with or without RGS data added) or RGS and BPE data are used to derive an average void fraction distribution for a waste form. When available for a specific tank, RGS and VFI data are combined into a single average. A distribution of individual RGS segment voids is not appropriate to characterize a tank average void since, at present, there are very few data points per tank (e.g., three to six) and they represent local effects. Therefore, in the cases where RGS data are available, it is only appropriate to use them to develop an average void fraction distribution for each waste form.

Table D-6 summarizes the BPE evaluation final results. The actual values used for the tank void fraction means or the default distribution regression are identified in the “Validated void fraction from dL/dP data” column.

The average void fraction distribution determined for a specific tank from VFI data (with or without RGS data added) or BPE should be used in preference to the default void fraction distribution for the tank waste form.

Table D-6. Void Fraction Data from Barometric Pressure Effect and Related Data to Calculate Void Fraction. (4 sheets)

Tank name	Waste type	Effective Pressure (psi)	Calculated void fraction (unitless)	Calculated retained gas volume (acf)	Validated void fraction from dL/dP data
241-A-101	SC/SS-NL	18.78	0.086	5,124	Adopted value 0.086
241-A-103	SC/SS-NL	18.35	0.004	179	Adopted value 0.004
241-A-106	MIX-NL	15.65	NA	-59	Dropped due to zero or positive dL/dP
241-AN-101	SC/SS-LIQ	16.88	NA	0	Dropped due to zero or positive dL/dP
241-AN-103	SC/SS-LIQ	29.43	0.215	11,802	Adopted value 0.215
241-AN-104	SC/SS-LIQ	29.93	0.084	5,070	Adopted value 0.084
241-AN-105	SC/SS-LIQ	31.13	0.064	4,200	Adopted value 0.064
241-AW-101	SC/SS-LIQ	32.59	0.152	6,229	Adopted value 0.152
241-AW-103	SL-LIQ	19.19	0.009	417	Adopted value 0.009
241-AW-104	SC/SS-LIQ	31.17	0.058	1,776	Adopted value 0.058
241-AW-105	SL-LIQ	18.56	NA	-14	Dropped due to zero or positive dL/dP
241-AW-106	SC/SS-LIQ	21.2	0.032	985	Adopted value 0.032
241-AX-101	SC/SS-NL	18.21	0.002	41	Updated value w/ 100 ft ³ RG 0.002 Not used – too far from RGS sample 0.170
241-AX-102	SC/SS-NL	14.96	NA	-56	Dropped due to zero or positive dL/dP

Table D-6. Void Fraction Data from Barometric Pressure Effect and Related Data to Calculate Void Fraction. (4 sheets)

Tank name	Waste type	Effective Pressure (psi)	Calculated void fraction (unitless)	Calculated retained gas volume (acf)	Validated void fraction from dL/dP data
241-AX-103	SC/SS-NL	15.71	NA	24	Dropped due to no liquid layer
241-AX-104	SL-NL	14.75	NA	0	Dropped due to zero or positive dL/dP
241-AY-101	SL-NL	16.11	0.042	604	Adopted value 0.042
241-AY-102	SL-LIQ	22.09	0.011	298	Dropped due to waste transfer interrupt
241-AZ-101	SL-LIQ	27.53	NA	-1,919	Dropped due to zero or positive dL/dP
241-B-102	SC/SS-NL	15.2	0.027	11	Updated value w/ 100 ft ³ RG 0.027
241-B-112	MIX-NL	15.16	0.025	23	Updated value w/ 100 ft ³ RG 0.025
241-BX-101	SL-NL	15.23	0.020	114	Adopted value 0.02
241-BX-102	SL-NL	15.59	NA	35	Dropped due to no liquid layer
241-BX-103	SL-NL	15.53	0.012	35	Updated value w/ 100 ft ³ RG 0.012
241-BX-104	SL-NL	15.73	0.075	967	Adopted value 0.075
241-BX-105	MIX-NL	15.34	0.016	23	Updated value w/ 100 ft ³ RG 0.016
241-BX-106	SC/SS-NL	15.14	NA	-11	Dropped due to zero or positive dL/dP
241-BX-107	SL-NL	17.51	0.025	1,155	Adopted value 0.025
241-BX-108	SL-NL	15.05	NA	-11	Dropped due to zero or positive dL/dP
241-BX-109	SL-NL	16.33	NA	86	Dropped due to no liquid layer
241-BX-110	MIX-NL	16.81	0.040	1,084	Adopted value 0.040
241-BX-111	SC/SS-NL	16.37	0.005	25	Updated value w/ 100 ft ³ RG 0.005
241-BX-112	SL-NL	16.14	0.005	109	Adopted value 0.005
241-C-103	SL-NL	16.8	0.006	13	Updated value w/ 100 ft ³ RG 0.006
241-C-106	SL-NL	15.5	NA	-105	Dropped due to zero or positive dL/dP
241-C-107	SL-NL	16.82	NA	50	Dropped due to no liquid layer
241-S-101	MIX-NL	18.8	0.043	2,410	Adopted value 0.043
241-S-102	SC/SS-NL	19.57	NA	7,599	Dropped due to no liquid layer
241-S-103	SC/SS-NL	17.3	0.147	4,526	Adopted value 0.147
241-S-106	SC/SS-NL	19.74	0.082	4,676	Adopted value 0.082
241-S-107	SL-NL	17.84	0.024	1,163	Adopted value 0.024
241-S-108	SC/SS-NL	18.99	NA	14	Dropped due to no liquid layer
241-S-110	SC/SS-NL	18.55	NA	-362	Dropped due to zero or positive dL/dP
241-S-111	SC/SS-NL	20.82	0.119	6,820	Adopted value 0.119
241-SX-101	MIX-NL	19.33	NA	21,922	Dropped due to no liquid layer
241-SX-103	SC/SS-NL	21.03	NA	48,914	Dropped due to no liquid layer
241-SX-104	MIX-NL	19.16	NA	804	Dropped due to no liquid layer
241-SX-105	SC/SS-NL	21.06	NA	50,215	Dropped due to no liquid layer

Table D-6. Void Fraction Data from Barometric Pressure Effect and Related Data to Calculate Void Fraction. (4 sheets)

Tank name	Waste type	Effective Pressure (psi)	Calculated void fraction (unitless)	Calculated retained gas volume (acf)	Validated void fraction from dL/dP data
241-SX-106	SC/SS-NL	19.78	0.140	6,034	Adopted value 0.140
241-SY-102	SL-LIQ	23.5	0.009	106	Adopted value 0.009
241-SY-103	SC/SS-LIQ	25.56	0.078	3,755	Adopted value 0.078
241-T-101	MIX-NL	15.83	0.007	12	Updated value w/ 100 ft ³ RG 0.007
241-T-102	SL-NL	15.18	NA	0	Dropped due to zero or positive dL/dP
241-T-107	SL-NL	16.18	NA	291	Dropped due to no liquid layer
241-T-108	MIX-NL	15.28	NA	149	Dropped due to no liquid layer
241-T-109	SC/SS-NL	15.41	NA	35	Dropped due to no liquid layer
241-TX-101	SL-NL	15.54	0.009	23	Updated value w/ 100 ft ³ RG 0.009
241-TX-102	SC/SS-NL	16.86	NA	19,841	Dropped due to no liquid layer
241-TX-103	SC/SS-NL	16.31	NA	1,223	Dropped due to no liquid layer
241-TX-104	MIX-NL	15.55	0.012	23	Updated value w/ 100 ft ³ RG 0.012
241-TX-105	SC/SS-NL	20.44	NA	15	Dropped due to no liquid layer
241-TX-106	SC/SS-NL	17.99	NA	27	Dropped due to no liquid layer
241-TX-107	SC/SS-NL	15.22	0.021	34	Updated value w/ 100 ft ³ RG 0.021
241-TX-108	SC/SS-NL	16.1	NA	-48	Dropped due to zero or positive dL/dP
241-TX-109	SL-NL	17.8	NA	27	Dropped due to no liquid layer
241-TX-110	SC/SS-NL	19.1	NA	57	Dropped due to no liquid layer
241-TX-111	SC/SS-NL	18.26	NA	-14	Dropped due to zero or positive dL/dP
241-TX-112	SC/SS-NL	20.8	NA	31	Dropped due to no liquid layer
241-TX-113	SC/SS-NL	20.46	NA	0	Dropped due to zero or positive dL/dP
241-TX-114	SC/SS-NL	19.76	NA	0	Dropped due to zero or positive dL/dP
241-TX-115	SC/SS-NL	20.06	NA	60	Dropped due to no liquid layer
241-TX-116	SC/SS-NL	20.64	NA	31	Dropped due to no liquid layer
241-TX-117	SC/SS-NL	20.59	NA	-15	Dropped due to zero or positive dL/dP
241-TX-118	SC/SS-NL	17.62	NA	-33	Dropped due to zero or positive dL/dP
241-TY-101	MIX-NL	15.96	NA	48	Dropped due to no liquid layer
241-TY-102	SC/SS-NL	15.46	NA	93	Dropped due to no liquid layer
241-TY-103	MIX-NL	16.17	NA	170	Dropped due to no liquid layer
241-TY-104	SL-NL	15.22	0.017	23	Updated value w/ 100 ft ³ RG 0.017
241-TY-105	SL-NL	16.62	NA	112	Dropped due to no liquid layer
241-TY-106	SL-NL	15.01	NA	34	Dropped due to no liquid layer
241-U-103	SC/SS-NL	19.33	0.080	4,839	Adopted value 0.080
241-U-105	SC/SS-NL	19.25	0.073	3,708	Adopted value 0.073

Table D-6. Void Fraction Data from Barometric Pressure Effect and Related Data to Calculate Void Fraction. (4 sheets)

Tank name	Waste type	Effective Pressure (psi)	Calculated void fraction (unitless)	Calculated retained gas volume (acf)	Validated void fraction from dL/dP data
241-U-106	SC/SS-NL	17.01	0.015	434	Adopted value 0.015
241-U-107	SC/SS-NL	18.96	0.076	3,795	Adopted value 0.076
241-U-109	SC/SS-NL	19.56	0.041	2,419	Adopted value 0.041
241-U-110	SL-NL	16.28	NA	-49	Dropped due to zero or positive dL/dP

Notes:

- MIX-NL = mixed waste form with < 1 m liquid over solids
- NA = not applicable.
- SC/SS-LIQ = saltcake/salt slurry waste form with \geq 1m liquid over solids.
- SC/SS-NL = saltcake/salt slurry waste form with < 1m liquid over solids.
- SL-LIQ = sludge waste form with \geq 1 m liquid over solids.
- SL-NL = sludge waste form with < 1 m liquid over solids.

D7.3 DEFAULT VOID FRACTIONS FOR EACH WASTE TYPE

The void fraction analysis was performed based on the type of waste found in the tanks. A full discussion of the waste type classification can be found in SNL-000198 and RPP-6171. Default distributions are generated for the following waste categories: saltcake/salt slurry waste without at least 1 m of supernatant liquid (SC/SS-NL), sludge waste without at least 1 m of supernatant liquid (SL-NL), saltcake/salt slurry waste with at least 1 m of supernatant liquid (SC/SS-LIQ), sludge waste with at least 1 m of supernatant liquid (SL-LIQ), liquid waste (LIQUID), mixed waste without at least 1 m of supernatant liquid (MIX-NL), and mixed waste with at least 1 m of supernatant liquid (MIX-LIQ). The void fraction results are grouped together to conservatively estimate void fractions for waste types, which do not have sufficient void fraction data to perform a valid statistical analysis. A complete listing of the tanks and their waste types can be found in Appendix H.

D7.3.1 SC/SS-NL and MIX-NL Default Void Fraction

The data for SC/SS-NL and MIX-NL wastes (Table D-7) have been regressed using Crystal Ball to fit a normal distribution which is then truncated to bound the values to those expected for the void fraction for the given waste type as shown in Figure D-3. The original boundary recommendations are presented in SNL-000198. The graph represents a truncated normal distribution with a mean and standard deviation as shown below. The default void fraction of 8.84 and its statistical distribution for SC/SS-NL and MIX-NL waste is given in Table D-8.

**Table D-7. Summary of Mean Void Fraction Data
for SC/SS-NL and MIX-NL Tanks With Measured Values. (2 sheets)**

Tank ID	BPE data^a	BPE method calc'd retained gas volume (acf)	VFI only data	VFI+RGS data^b	Mahoney RGS void fraction^c	Huckaby/Whitney BPE data 10/01/03^d	Barker-Barnes 2/8/2006	Waste type
241-B-112	0.025	23	--	--	--	--		MIX-NL
241-BX-105	0.016	23	--	--	--	--	--	MIX-NL
241-BX-110	0.04	1,084	--	--	--	--	--	MIX-NL
241-S-101	0.043	2,410	--	--	--	--	--	MIX-NL
241-T-101	0.007	12	--	--	--	--	--	MIX-NL
241-TX-104	0.012	23	--	--	--	--	--	MIX-NL
241-A-101	0.086	5,124	--	--	0.18	--	--	SC/SS-NL
241-A-103	0.004	179	--	--	--	--	--	SC/SS-NL
241-AX-101	--	41	--	--	0.17	--	--	SC/SS-NL
241-B-102	0.027	11	--	--	--	--	--	SC/SS-NL
241-BX-111	0.005	25	--	--	--	--	--	SC/SS-NL
241-BY-109	--	86	--	--	0.094	--	--	SC/SS-NL
241-S-102	--	7,599	--	--	0.26	--	--	SC/SS-NL
241-S-103	0.147	4,526	--	--	--	--	--	SC/SS-NL
241-S-106	0.082	4,676	--	--	0.1	--	--	SC/SS-NL
241-S-111	0.119	6,820	--	--	0.15	--	--	SC/SS-NL
241-SX-106	0.14	6,034	--	--	0.14	--	--	SC/SS-NL
241-TX-107	0.021	34	--	--	--	--	--	SC/SS-NL
241-U-103	0.08	4,839	--	--	0.19	--	--	SC/SS-NL
241-U-105	0.073	3,708	--	--	--	--	--	SC/SS-NL
241-U-106	0.015	434	--	--	--	--	--	SC/SS-NL
241-U-107	0.076	3,795	--	--	--	--	--	SC/SS-NL
241-U-109	0.041	2,419	--	--	0.22	--	--	SC/SS-NL

Notes:

References:

^aBased on BPE data from RPP-15488, 2004.^bPNNL-11536, 1997.^cPNNL-13317, 2000.^dRPP-10006, 2004.

BPE = barometric pressure effect.

MIX-NL = mixed waste from with < 1 m liquid over solids.

NA = not applicable.

RGS = retained gas sampler.

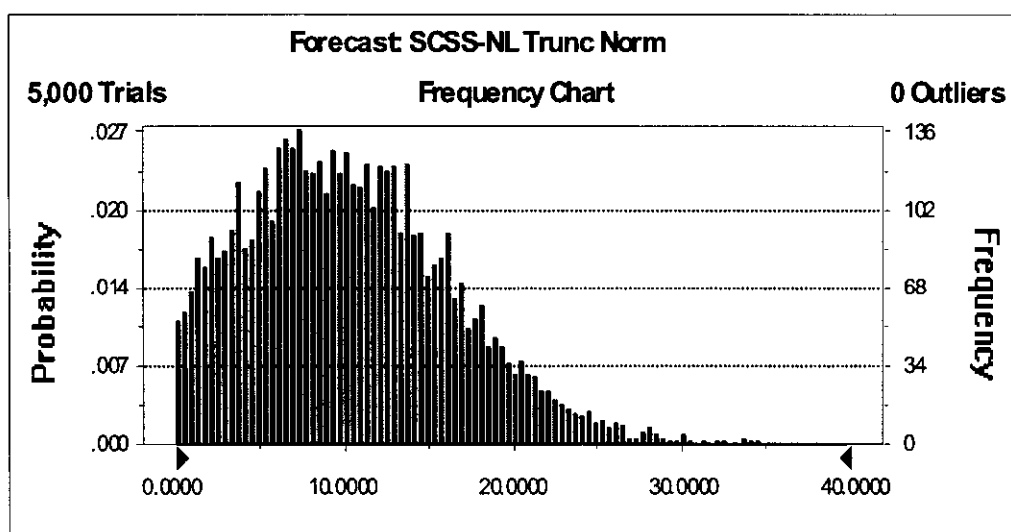
SC/SS-NL = saltcake/salt slurry waste form with < 1 m liquid over solids.

VFI = void fraction instrument.

Table D-8. Default Void Fraction for SC/SS-NL and MIX-NL Waste with Truncated Normal Distribution.

Mean	8.84
Standard deviation	7.13
Truncate low	0.01
Truncate high	40

Figure D-3. Void Fraction Regression Results for SC/SS-NL and MIX-NL Wastes.



D7.3.2 SL-NL Default Void Fraction

The data for SL-NL wastes (Table D-9) have been regressed using Crystal Ball to fit a normal distribution which is then truncated to bound the values to those expected for the given waste type void fraction, as shown in Figure D-4. The original boundary recommendations are presented in SNL-000198. Figure D-4 represents a truncated normal distribution with a mean and standard deviation as shown below. The default void fraction of 2.44 and the statistical distribution for SL-NL waste is given in Table D-10.

Table D-9. Summary of Average Void Fraction Data for SL-NL Tanks With Measured Values.

Tank ID	BPE data ^a	BPE method calc'd retained gas volume (acf)	VFI only data	VFI+RGS data ^b	Mahoney RGS void fraction ^c	Huckaby/Whitney BPE data 10/01/03 ^d	Barker-Barnes 2/8/2006	Waste type
241-AY-101	0.042	604	--	--	--	--	--	SL-NL
241-BX-101	0.02	114	--	--	--	--	--	SL-NL
241-BX-103	0.012	35	--	--	--	--	--	SL-NL
241-BX-104	0.075	967	--	--	--	--	--	SL-NL
241-BX-107	0.025	1,155	--	--	--	--	--	SL-NL
241-BX-112	0.005	109	--	--	--	--	--	SL-NL
241-C-103	0.006	13	--	--	--	--	--	SL-NL
241-S-107	0.024	1,163	--	--	--	--	--	SL-NL
241-TX-101	0.009	23	--	--	--	--	--	SL-NL
241-TY-104	0.017	23	--	--	--	--	--	SL-NL

Notes:

References:

^aBased on BPE data from RPP-15488, 2004.^bPNNL-11536, 1997.^cPNNL-13317, 2000.^dRPP-10006, 2004.

BPE = barometric pressure effect.

RGS = retained gas sampler.

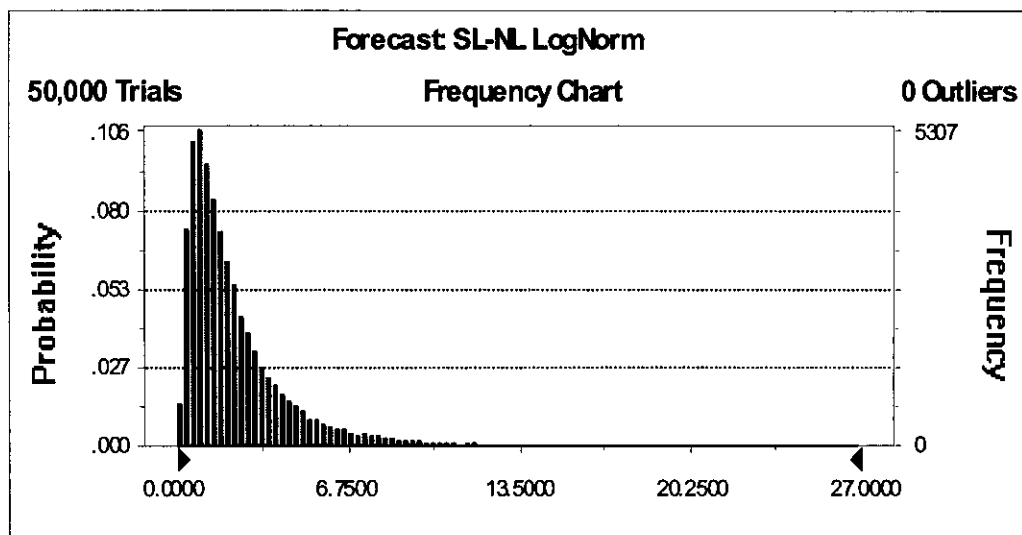
SL-NL = sludge waste form with < 1 m liquid over solids.

VFI = void fraction instrument.

Table D-10. The Default Void Fraction for SL-NL Waste with Truncated LogNormal Distribution.

Mean	2.44
Standard deviation	2.49
Truncate low	0.01
Truncate high	26.5

Figure D-4. Void Fraction Regression Results for SL-NL Wastes.



D7.3.3 SC/SS-LIQ, SL-LIQ, and MIX-LIQ Default Void Fraction

The data for SC/SS-LIQ wastes (Table D-11) have been regressed to fit a truncated normal distribution as shown in Figure D-5. Figure D-5 represents a truncated normal distribution with a mean and standard deviation as shown below. In addition, wastes with significant supernatant (greater than 1 m depth) have an upper bound at the neutral buoyancy void fraction for the waste. The modification of the upper limit of the void fraction to account for the neutral buoyancy void fraction within a given tank is done within the model at execution time and is not reflected here. The default void fraction of 6.37 and its statistical distribution for SC/SS-LIQ waste is given in Table D-12.

Although no SL-LIQ or MIX-LIQ waste type tanks are used in the regression of this default distribution, the SC/SS-LIQ default distribution will be applied to SL-LIQ and MIX-LIQ tanks.

Table D-11. Summary of Average Void Fraction Data for SC/SS-LIQ Tanks With Measured Values.

Tank ID	BPE data ^a	BPE method calc'd retained gas volume (acf)	VFI only data	VFI+RGS data ^b	Mahoney RGS void fraction ^c	Huckaby /Whitney BPE data 10/01/03 ^d	Barker-Barnes 2/8/2006	Waste type
241-AN-103	0.215 ^e	11,802	0.122	0.107	0.092	--	--	SC/SS-LIQ
241-AN-104	0.084	5,070	0.059	0.062	0.08	--	--	SC/SS-LIQ
241-AN-105	0.064	4,200	0.038	0.042	0.051	--	--	SC/SS-LIQ
241-AN-107	--	--	--	--	--	--	0.011	SC/SS-LIQ
241-AW-101	0.152 ^e	6,229	0.047	0.038	0.037	--	--	SC/SS-LIQ
241-AW-104	0.058	1,776	--	--	--	--	--	SC/SS-LIQ
241-AW-106	0.032	985	--	--	--	--	--	SC/SS-LIQ
241-SY-101	--	--	--	--	--	0.091	0.085	SC/SS-LIQ
241-SY-103	0.078	3,755	0.06	--	--	--	--	SC/SS-LIQ

Notes:

References:

^aBased on BPE data from RPP-15488, 2004.^bPNNL-11536, 1997.^cPNNL-13317, 2000.^dRPP-10006, 2004.^eData not used since it appears to be inconsistent with higher quality data.

BPE = barometric pressure effect.

RGS = retained gas sampler.

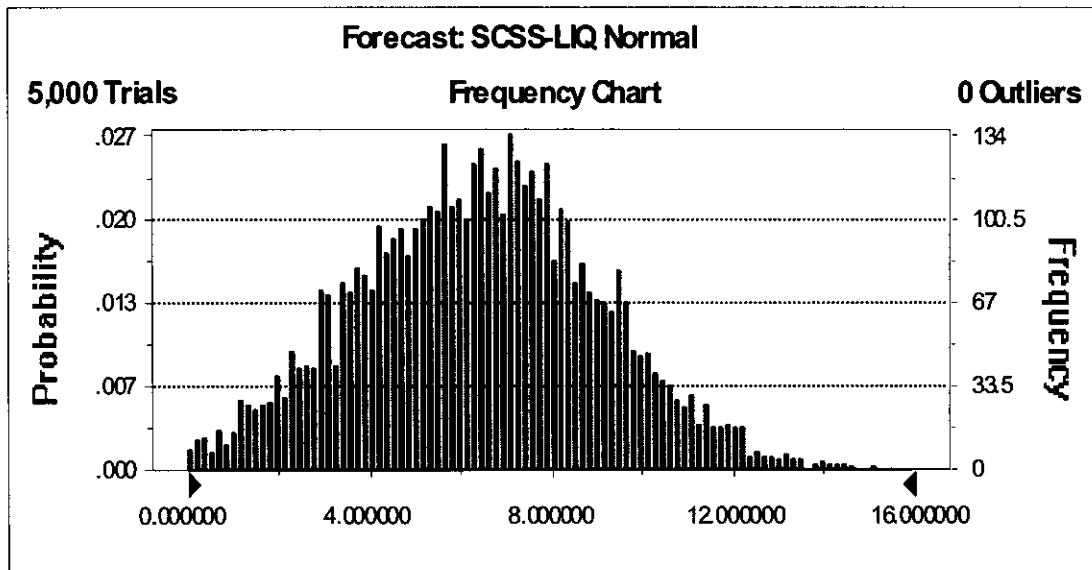
SC/SS-LIQ = saltcake/salt slurry waste form with ≥ 1 m liquid over solids.

VFI = void fraction instrument.

Table D-12. Default Void Fraction for SC/SS-LIQ, SL-LIQ, and MIX-LIQ Waste with Truncated Normal Distribution.

Mean	6.37
Standard deviation	2.73
Truncate low	0.01
Truncate high	15.11

Figure D-5. Void Fraction Regression Results for SC/SS-LIQ, SL-LIQ, and MIX-LIQ Wastes.



D7.3.4 Liquid Waste Void Fractions

Liquid wastes do not retain gas. Any gas found in the liquid wastes is considered transient and is not considered as trapped or retained gas. Therefore, the void fraction for liquid waste is set to 0.0. In order to comply with Crystal Ball run-time requirements, the mean of the liquid distribution will be set to 0.15 vol % gas, otherwise simulations with liquid wastes will fail.

D7.4 VOID FRACTION ASSIGNMENT FOR 177 DOUBLE-SHELL TANKS AND SINGLE-SHELL TANKS

Table D-13 presents the void fraction distributions and their source for tanks with void fraction measurements. All other tanks use default distributions based on waste type.

Table D-13. Void Percent Distributions for Non-Default Tanks. (2 sheets)

Tank	Void Percent or Maximum Wetted Solids Void Percent					Data source	Waste type
	Mean (%)	Uncertainty (%)	Minimum (%)	Maximum (%)	Distribution (%)		
241-A-103	0.40	0.20	0.01	40.00	Normal	BPE	SC/SS-NL
241-AN-103	10.70	5.35	0.01	15.11	Normal	RGS/VFI	SC/SS-LIQ
241-AN-104	6.20	3.10	0.01	15.11	Normal	RGS/VFI	SC/SS-LIQ
241-AN-105	4.20	2.10	0.01	15.11	Normal	RGS/VFI	SC/SS-LIQ
241-AN-107	1.10	0.55	0.01	15.11	Normal	BPE	SC/SS-LIQ
241-AW-101	4.70	2.35	0.01	15.11	Normal	RGS/VFI	SC/SS-LIQ
241-AW-103	0.90	0.45	0.01	15.11	Normal	BPE	SL-LIQ
241-AW-104	5.80	2.90	0.00	15.11	Normal	BPE	SC/SS-LIQ
241-AW-106	3.20	1.60	0.01	15.11	Normal	BPE	SC/SS-LIQ
241-AY-101	4.20	2.10	0.00	26.50	Normal	BPE	SL-NL
241-B-102	2.70	1.35	0.01	40.00	Normal	BPE	SC/SS-NL
241-B-112	2.50	1.25	0.01	40.00	Normal	BPE	MIX-NL
241-BX-101	2.00	1.00	0.00	26.50	Normal	BPE	SL-NL
241-BX-103	1.20	0.60	0.00	26.50	Normal	BPE	SL-NL
241-BX-104	7.50	3.75	0.00	26.50	Normal	BPE	SL-NL
241-BX-105	1.60	0.80	0.01	40.00	Normal	BPE	MIX-NL
241-BX-107	2.50	1.25	0.00	26.50	Normal	BPE	SL-NL
241-BX-110	4.00	2.00	0.01	40.00	Normal	BPE	MIX-NL
241-BX-111	0.50	0.25	0.01	40.00	Normal	BPE	SC/SS-NL
241-BX-112	0.50	0.25	0.00	26.50	Normal	BPE	SL-NL
241-C-103	0.60	0.30	0.00	26.50	Normal	BPE	SL-NL
241-S-101	4.30	2.15	0.01	40.00	Normal	BPE	MIX-NL
241-S-103	14.70	7.35	0.01	40.00	Normal	BPE	SC/SS-NL
241-S-106	8.20	4.10	0.01	40.00	Normal	BPE	SC/SS-NL
241-S-107	2.40	1.20	0.01	26.50	Normal	BPE	SL-NL
241-S-111	11.90	5.95	0.01	40.00	Normal	BPE	SC/SS-NL
241-SX-106	14.00	7.00	0.01	40.00	Normal	BPE	SC/SS-NL
241-SY-101	8.50	4.25	0.00	15.11	Normal	BPE	SC/SS-LIQ
241-SY-102	0.90	0.45	0.01	15.11	Normal	BPE	SL-LIQ
241-SY-103	6.00	3.00	0.00	15.11	Normal	VFI	SC/SS-LIQ
241-T-101	0.70	0.35	0.01	40.00	Normal	BPE	MIX-NL
241-TX-101	0.90	0.45	0.01	26.50	Normal	BPE	SL-NL
241-TX-104	1.20	0.60	0.01	40.00	Normal	BPE	MIX-NL
241-TX-107	2.10	1.05	0.01	40.00	Normal	BPE	SC/SS-NL

Table D-13. Void Percent Distributions for Non-Default Tanks. (2 sheets)

Tank	Void Percent or Maximum Wetted Solids Void Percent					Data source	Waste type
	Mean (%)	Uncertainty (%)	Minimum (%)	Maximum (%)	Distribution (%)		
241-TY-104	1.70	0.85	0.01	26.50	Normal	BPE	SL-NL
241-U-103	8.00	4.00	0.01	40.00	Normal	BPE	SC/SS-NL
241-U-105	7.30	3.65	0.01	40.00	Normal	BPE	SC/SS-NL
241-U-106	1.50	0.75	0.01	40.00	Normal	BPE	SC/SS-NL
241-U-107	7.60	3.80	0.01	40.00	Normal	BPE	SC/SS-NL
241-U-109	4.10	2.05	0.01	40.00	Normal	BPE	SC/SS-NL

Notes:

- BPE = barometric pressure effect.
- LIQ = liquid
- MIX-LIQ = mixed waste form with ≥ 1 m liquid over solids.
- MIX-NL = mixed waste form with < 1 m liquid over solids.
- RGS = retained gas sampler.
- SC/SS-LIQ = saltcake/salt slurry waste form with ≥ 1 m liquid over solids.
- SC/SS-NL = saltcake/salt slurry waste form with < 1 m liquid over solids.
- SL-LIQ = sludge waste form with ≥ 1 m liquid over solids.
- SL-NL = sludge waste form with < 1 m liquid over solids.
- VFI = void fraction instrument.

D8.0 CONCLUSIONS

The field measured data from VFI, RGS, and BPE have been thoroughly examined to determine, calculate, and develop the void fractions for the 177 DSTs and SSTs. The void fraction is being validated, adopted, and calculated using 39 of the 86 dL/dP data points from RPP-15884. In addition, dL/dP data have been developed for DSTs 241-AN-107 and 241-SY-101, and the void fractions were calculated. The dL/dP data from Huckaby (RPP-10006, *Methodology and Calculations for the Assignment of Waste for the Large Underground Storage Tanks at Hanford Site*, Rev. 3) and the void fraction data reported using VFI and RGS have been used to develop three default void fractions for SC/SS-NL and MIX-NL waste types, for SL-NL waste type, and for SC/SS-LIQ, SL-LIQ and MIX-LIQ waste types.

D9.0 REFERENCES

- HNF-EP-0182-130, 1999, *Waste Tank Summary Report for Month Ending 01/31/1999*, Lockheed Martin Hanford Corporation, Richland, Washington.
- PNL-10821, 1995, *Screening the Hanford Tanks for Trapped Gas*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11373, 1996, *Flammable Gas Data Evaluation Progress Report*, Pacific Northwest National Laboratory, Richland Washington.
- PNNL-11450, 1997, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-AW-101, A-101, AN-105, AN-104, and AN-103*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11536, 1997, *Gas Retention and Release Behavior in Hanford Double-Shell Waste Tanks*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11693, 1997, *Estimating Retained Gas Volumes in the Hanford Tanks using Waste Level Measurements*, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-11777, 1997, *Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-U-103, S-106, BY-101, and BY-109*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.
- PNNL-13317, 2000, *Ammonia Results Review for Retained Gas Sampling*, Pacific Northwest National Laboratory, Richland, Washington.
- RPP-5926, 2000, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-5926, 2005, *Steady-State Flammable Gas Release Rate Calculation or Lower Flammability Evaluation Level for Hanford Tank Waste*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6171, 2000, *Determination of Waste Groupings for Safety Analyses*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-10006, 2004, *Methodology and Calculations for the Assignment of Waste for the Large Underground Storage Tanks at Hanford Site*, Rev. 3, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-15488, 2004, *Investigation of Tank Void Fraction Using Liquid Level to Atmospheric Pressure Changes*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-29388, 2006, *Spreadsheet Description Document For 'SVF 1131 BPE to Void Fraction Master R0 060221 .xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-29389, 2006, *Spreadsheet Description Document For 'RPP-10006r5 Void fraction revised data by tank - 060519 .xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

SNL-000198, 1999, *Flammable Gas Safety Analysis Data Review*, Sandia National Laboratory, Albuquerque, New Mexico.

SVF-1002, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'BP Correlation with DB Connect .xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

SVF-1131, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'SVF 1131 BPE to Void Fraction Master R0 060221 .xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

SVF-1132, 2006, *Spreadsheet Verification and Release Form for Spreadsheet 'RPP-10006r5 Void fraction revised data by tank - 060519 .xls'*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

APPENDIX E

DETERMINATION OF HYDROGEN GENERATION RATE DISTRIBUTION RANGES

This page intentionally left blank.

CONTENTS

E1.0	OBJECTIVE	E-1
E2.0	BACKGROUND	E-1
E3.0	HYDROGEN GENERATION RATE DISTRIBUTIONS	E-1
E4.0	COMPUTER SOFTWARE USE AND VERIFICATION.....	E-6
E5.0	RESULTS.....	E-6
E6.0	REFERENCES	E-6

TABLES

Table E-1.	Comparison of Model-Calculated and Field-Observed Hydrogen Generation Rates (HNF-3851).....	2
Table E-3.	Hydrogen Generation Rate Distribution for Tanks with $1.5\text{E-}03 \text{ ft}^3/\text{min} > \text{HGR}_{\text{est}} > 1.0\text{E-}03 \text{ ft}^3/\text{min}$	4
Table E-4.	Hydrogen Generation Rate Distribution for Tanks with $1.0\text{E-}03 \text{ ft}^3/\text{min} \geq \text{HGR}_{\text{est}}$	5

LIST OF TERMS

BBI	Best-Basis Inventory
BDGRE	buoyant displacement gas release event
CL	convective layer
DST	double-shell tank
HGR	hydrogen generation rate
NA	not applicable
NCL	nonconvective layer
RGS	retained gas solids
TOC	total organic carbon

APPENDIX E

DETERMINATION OF HYDROGEN GENERATION RATE DISTRIBUTION RANGES

E1.0 OBJECTIVE

The purpose of this appendix is to document the methodology used to determine the distribution ranges for the hydrogen generation rates (HGR) based on a comparison between calculated and observed HGRs as presented in HNF-3851, *Empirical Rate Equation Model and Rate Calculations of Hydrogen Generation for Hanford Tank Waste*.

E2.0 BACKGROUND

Updated solid phase unit HGRs are taken from the most current revision of RPP-5926 where possible. However corresponding maxima, minima and distribution types are not included in RPP-5926. The methodology for deriving these values was established in RPP-10006, Revision 5 and is used in subsequent revisions.

Tanks 241-AP-104, 241-AP-106 and 241-AP-107 do not have solid phase HGRs reported in RPP-5926. Therefore, the values from RPP-10006, Revision 5 will continue to be used for the previously identified solids in tanks 241-AP-104 and 241-AP-107. The unit HGR for newly identified solids in tank 241-AP-106 (new as of RPP-10006, Revision 7) is assumed to be the same as for the solids in tank 241-AP-104.

E3.0 HYDROGEN GENERATION RATE DISTRIBUTIONS

The HGR distributions are based on the evaluation of model-calculated and field-observed rates from HNF-3851, as presented in Table E-1. In Table E-1, positive "Relative Differences" indicate overestimation of the HGR; negative "Relative Differences" indicate model underestimation of the HGR.

Table E-1. Comparison of Model-Calculated and Field-Observed Hydrogen Generation Rates (HNF-3851).

Tanks	G_{mod} (ft ³ /min) total HGR from model	G_{field} (ft ³ /min) total HGR from field	G_{mod} (L/day) total HGR from model	G_{field} (L/day) total HGR from field	Relative differences [model vs. field data]
241-AN-101	1.73E-04	2.50E-04	7	10	-31%
241-U-107	4.71E-04	8.27E-04	19	34	-43%
241-U-109	5.44E-04	7.11E-04	22	29	-23%
241-SX-101	6.64E-04	4.20E-04	27	17	58%
241-U-108	9.42E-04	1.41E-03	39	57	-33%
241-SY-102	9.66E-04	7.26E-04	40	30	33%
241-U-102	1.05E-03	1.10E-03	43	45	-4%
241-U-106	1.12E-03	6.62E-04	46	27	69%
241-S-102	1.25E-03	1.64E-03	51	67	-24%
241-SX-104	1.31E-03	2.51E-04	53	10	420%
241-U-105	1.37E-03	1.61E-03	56	65	-15%
241-U-103	1.46E-03	1.48E-03	60	60	-1%
241-SX-106	1.53E-03	1.24E-03	63	50	24%
241-C-104	2.56E-03	2.21E-03	105	90	16%
241-SX-103	3.03E-03	1.27E-03	124	52	139%
241-AW-101	3.55E-03	3.17E-03	146	129	12%
241-SY-103	3.63E-03	3.54E-03	149	145	2%
241-AN-103	4.54E-03	4.76E-03	186	195	-5%
241-AN-105	5.14E-03	3.06E-03	211	125	68%
241-AN-104	5.53E-03	2.55E-03	227	104	117%
241-A-101	5.76E-03	2.14E-03	236	87	169%
241-SX-105	5.77E-03	4.82E-03	236	197	20%
241-AN-107	1.09E-02	5.25E-03	447	214	108%
241-C-106	1.62E-02	9.03E-03	664	368	79%
241-AY-102	2.10E-02	1.70E-02	859	691	24%
241-AZ-101	2.79E-02	9.44E-03	1144	385	196%
241-AZ-102	2.90E-02	1.90E-02	1190	775	53%
241-SY-101	5.96E-02	2.44E-02	2441	993	145%

Notes:

HNF-3851, 2004, *Empirical Rate Equation Model and Rate Calculations of Hydrogen Generation for Hanford Tank Waste*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland Washington.

HGR = hydrogen generation rate.

Based on the evaluations given below the HGR distributions are described by a triangular distribution with the upper and lower bounds defined as listed below.

<u>Model Estimated HGR</u>	<u>Upper Bound</u>	<u>Lower Bound</u>
$HGR_{est} \geq 1.5E-03 \text{ (ft}^3/\text{min)}$	$1.1 * HGR_{est}$	$HGR_{est} / 3$
$1.5E-03 > HGR_{est} \geq 1.0E-03 \text{ (ft}^3/\text{min)}$	$1.5 * HGR_{est}$	$HGR_{est} / 2$
$1.0E-03 \text{ (ft}^3/\text{min)} > HGR_{est}$	$1.9 * HGR_{est}$	$HGR_{est} / 2$

Notes HGR_{est} = estimated HGR

The model estimated HGR is the total HGR for the tank. It is assumed that the nonconvective layer HGR has the same upper and lower bound relationships as used for the specific tank's total HGR.

Previously, the distribution maxima and minima for the HGRs were defined loosely as the " $HGR_{mean} + 2 \text{ times } HGR_{mean}$ " and " $HGR_{mean} - HGR_{mean} / 2$," respectively. When tanks are arranged in order from smallest to largest HGR it was found that the larger model HGRs consistently overestimated the observed HGRs and the smaller HGRs typically underestimated the observed HGRs. As a result, it was decided to divide the range of model-generated HGR values such that the ranges of the observed HGRs were underestimated, overestimated, or mixed (overestimated and underestimated).

The range of HGRs was arbitrarily divided in to the following three groups:

- $HGR_{est} \geq 1.5E-03 \text{ ft}^3/\text{min}$
- $1.5E-03 \text{ ft}^3/\text{min} \geq HGR_{est} \geq 1.0E-03 \text{ ft}^3/\text{min}$
- $1.0E-03 \text{ ft}^3/\text{min} \geq HGR_{est}$.

For tanks with $HGR_{est} > 1.5E-03 \text{ ft}^3/\text{min}$, the data ranges from underestimating the observed value by 5% (only 1 value underestimated the observed value) to overestimating the observed HGR by a factor of 3 (15 values overestimated the observed HGR). The distribution ranges were set to encompass the range of observations in this bin. To cover the underestimated values, the upper bound for the range was set to "110 % of the mean" (100% plus twice "the relative difference for 241-AN-103"), and the lower bound was set to the "mean /3" (the mean divided by "100% plus the relative difference for 241-AZ-101"). The resulting distributions for this range of data are presented in Table E-2.

Six tanks fell into the tanks with $1.5E-03 \text{ ft}^3/\text{min} > HGR_{est} > 1.0E-03 \text{ ft}^3/\text{min}$ bin. Of these, four tanks underestimated the HGR by up to 25%, and two tanks overestimated the HGR by up to 420%. To account for this range, the underestimated values the upper bound for the range was set to "150 % of the mean" (100% plus twice "the relative difference for 241-S-102"), and the lower bound was set to the "mean /2" (the mean divided by "100% plus ¼ of the relative difference for 241-SX-104." This is a conservative assumption). The resulting distributions for this range of data are presented in Table E-3.

Table E- 2. Hydrogen Generation Rate Distribution for
Tanks with $HGR_{est} > 1.5E-03 \text{ ft}^3/\text{min}$.

Tanks	G_{mod} (ft^3/min) total HGR from model	G_{field} (ft^3/min) total HGR from field	G_{mod} (L/day) total HGR from model	G_{field} (L/day) total HGR from field	Relative differences (model vs. field data)	Resulting distribution using $HGR_{est}/3 \leq HGR_{est} \leq 1.10 * HGR_{est}$		
						Lower bound (L/day)	Mean (L/day)	Upper bound (L/day)
241-AN-103	4.54E-03	4.76E-03	186	195	-5%	62	186	204
241-SY-103	3.63E-03	3.54E-03	149	145	2%	50	149	163
241-AW-101	3.55E-03	3.17E-03	146	129	12%	49	146	160
241-C-104	2.56E-03	2.21E-03	105	90	16%	35	105	115
241-SX-105	5.77E-03	4.82E-03	236	197	20%	79	236	260
241-AY-102	2.10E-02	1.70E-02	859	691	24%	286	859	945
241-SX-106	1.53E-03	1.24E-03	63	50	24%	21	63	69
241-AZ-102	2.90E-02	1.90E-02	1,190	775	53%	397	1,190	1,309
241-AN-105	5.14E-03	3.06E-03	211	125	68%	70	211	232
241-C-106	1.62E-02	9.03E-03	664	368	79%	221	664	730
241-AN-107	1.09E-02	5.25E-03	447	214	108%	149	447	492
241-AN-104	5.53E-03	2.55E-03	227	104	117%	76	227	249
241-SX-103	3.03E-03	1.27E-03	124	52	139%	41	124	137
241-SY-101	5.96E-02	2.44E-02	2,441	993	145%	814	2,441	2,685
241-A-101	5.64E-03	2.14E-03	231	87	164%	77	231	254
241-AZ-101	2.79E-02	9.44E-03	1,144	385	196%	381	1,144	1,258

Note: HGR = hydrogen generation rate.

Table E-3. Hydrogen Generation Rate Distribution for
Tanks with $1.5E-03 \text{ ft}^3/\text{min} > HGR_{est} > 1.0E-03 \text{ ft}^3/\text{min}$.

Tanks	G_{mod} (ft^3/min) total HGR from model	G_{field} (ft^3/min) total HGR from field	G_{mod} (L/day) total HGR from model	G_{field} (L/day) total HGR from field	Relative differences (model vs. field data)	Resulting distribution using $HGR_{est}/2 \leq HGR_{est} \leq 1.5 * HGR_{est}$		
						Lower bound (L/day)	Mean (L/day)	Upper bound (L/day)
241-S-102	1.25E-03	1.64E-03	51	67	-24%	26	51	77
241-U-105	1.37E-03	1.61E-03	56	65	-15%	28	56	84
241-U-102	1.05E-03	1.10E-03	43	45	-4%	22	43	65
241-U-103	1.46E-03	1.48E-03	60	60	-1%	30	60	90
241-U-106	1.12E-03	6.62E-04	46	27	69%	23	46	69
241-SX-104	1.31E-03	2.51E-04	53	10	420%	27	53	80

Note: HGR = hydrogen generation rate.

Six tanks fell into the $1.0\text{E-}03 \text{ ft}^3/\text{min} \geq \text{HGR}_{\text{est}}$ bin. Of these, four tanks underestimated the HGR by up to 43%, and two tanks overestimated the HGR by up to 60%. To account for this range, the underestimated values the upper bound for the range was set to “190 % of the mean” (100% plus twice “the relative difference for 241-U-107”), and the lower bound was set to the “mean /2” (the mean divided by “100% plus ~2 times of the relative difference for 241-SX-101”). The resulting distributions for this range of data are presented in Table E-4.

Table E-4. Hydrogen Generation Rate Distribution for Tanks with $1.0\text{E-}03 \text{ ft}^3/\text{min} \geq \text{HGR}_{\text{est}}$.

Tanks	G_{mod} (ft^3/min) total HGR from model	G_{field} (ft^3/min) total HGR from feld	G_{mod} (L/day) total HGR from model	G_{field} (L/day) total HGR from field	Relative differences (model vs. field data)	Resulting distribution using $\text{HGR}_{\text{est}}/2 \leq \text{HGR}_{\text{est}} \leq 1.9 * \text{HGR}_{\text{est}}$		
						Lower bound (L/day)	Mean (L/day)	Upper bound (L/day)
241-U-107	4.71E-04	8.27E-04	19	34	-43%	10	19	37
241-U-108	9.42E-04	1.41E-03	39	57	-33%	19	39	73
241-AN-101	1.73E-04	2.50E-04	7	10	-31%	4	7	13
241-U-109	5.44E-04	7.11E-04	22	29	-23%	11	22	42
241-SY-102	9.66E-04	7.26E-04	40	30	33%	20	40	75
241-SX-101	6.64E-04	4.20E-04	27	17	58%	14	27	52
Note: HGR = hydrogen generation rate.								

E4.0 COMPUTER SOFTWARE USE AND VERIFICATION

The spreadsheet used to determine the HGR distribution limits is described below:

- Microsoft Excel¹ 2003 was used to create the spreadsheet
- Spreadsheet owner: S. A. Barker
- Spreadsheet file name: RPP-10006r4 HGR Dists 041014 .xls
- File location²: \\AP003\Baro\SteveB\RPP-10006r4\ DatabaseBuild
- The spreadsheet is verified and documented in Spreadsheet Verification and Release Form SVF-269 *Spreadsheet Verification and Release Form for RPP-10006r4 HGR Dists 041014 .xls*, Rev. 0.

E5.0 RESULTS

Appendix H lists the solid phase HGRs along with associated maximum and minimum values.

E6.0 REFERENCES

HNF-3851, 2004, *Empirical Rate Equation Model and Rate Calculations of Hydrogen Generation for Hanford Tank Waste*, Rev 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

Personal Computer-Surveillance Analysis Computer System (PCSACS), Queried on 2/14/2006, [DST 241-AP-103 and 241-AP-108 temperatures for 2/1/2005 through 2/14/2006], HISI ID No. 242.

RPP-5926, 2005, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 5, CH2M HILL Hanford Group, Inc, Richland, Washington.

RPP-10006, 2006, *Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.

SVF-269, *Spreadsheet Verification and Release Form for RPP-10006r4 HGR Dists 041014 .xls*, CH2M HILL Hanford Group, Inc., Richland, Washington.

¹ Microsoft Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

² The content of network share \\AP003\Baro has been transitioned to network share \\Hanford\data\sitedata\Baro.

APPENDIX F

**WELLS, B. E., AND S. A. BARKER,
2003,
SUMMARY OF YIELD STRESS IN SHEAR DATA FOR HANFORD WASTE,
TWS03.044,
PACIFIC NORTHWEST NATIONAL LABORATORY,
RICHLAND, WASHINGTON**

This page intentionally left blank

TWS03.044

**Pacific Northwest
National Laboratory**

Operated by Battelle for the
U.S. Department of Energy

September 15, 2003

Bill Cowley, Manager
Flammable Gas Project
CH2M HILL Hanford Group, Inc.
MSIN S4-44
Richland, WA 99352

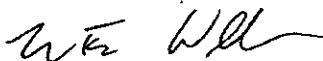
Dear Bill:

SUMMARY OF YIELD STRESS IN SHEAR DATA FOR HANFORD WASTE

Enclosed is PNNL letter report TWS03.044, *Summary of Yield Stress in Shear Data for Hanford Waste*, by BE Wells and SA Barker.

If you have any questions, please call me at 375-6671. Changes to distribution can be made by e-mail or phone.

Sincerely,



Beric E. Wells, Manager
PNNL Flammable Gas Project

BEW:ekm

cc:	File T1.3.1/LB	
	SA Barker	S7-90
	WL Cowley	S4-44
	JM Grigsby	S7-90
	DC Hedengren	R1-44
	LJ Kripps	S7-90
	CHG Correspondence Control	H6-08
	TCSRC	R1-10

902 Battelle Boulevard • P.O. Box 999 • Richland, WA 99352

Telephone (509) 375-6671 ■ Email beric.wells@pnl.gov ■ Fax (509) 375-3865

This page intentionally left blank.

Summary of Yield Stress in Shear Data for Hanford Waste

BE Wells
Pacific Northwest National Laboratory

SA Barker
CH2MHILL Hanford Group, Inc.

September 2003

Pacific Northwest National Laboratory
Richland, Washington

LIMITED DISTRIBUTION NOTICE

This document is made available to the CH2M Hill Hanford Group, Inc. in confidence solely for use in performance of work under contracts with the U.S. Department of Energy. This document is not to be published or referenced in another publication, nor its contents otherwise disseminated or revealed or used for purposes other than specified above, without determination of final review authority. If the information contained herein is incorporated in a Hanford document, such document shall receive appropriate clearance.

1.0 Introduction

The Hanford waste tanks are categorized into waste groups based on the tank's retention of flammable gas and the potential for that gas to be released by a buoyant displacement gas release event (BDGRE). In support of this categorization, data pertaining to the yield stress in shear of the waste sediments are herein reviewed.

Waste management and retrieval issues such as flammable gas retention and release and waste mixing are dependent on the yield stress in shear of the waste sediment. The waste sediment is a solid, liquid, and gas matrix that varies in composition from tank to tank. Yield stress in shear, or shear strength as it is commonly referred to in Hanford literature, may be defined as the point at which the sediment material ceases to deform like a solid under applied stress but instead flows like a truly viscous material with a finite viscosity.

Limitations of available instrumentation, the varied sediment conditions and compositions, and the influence of the sediment history for a given tank or waste sample render the determination of in situ sediment shear strength a challenging task. In this document, sediments are grouped into categories similar to those of Barker and Lechelt (2000), and representative shear strength data pertaining to these waste types are reviewed.

In Section 2, an overview of shear strength measurement techniques used on the Hanford sediment is presented. Data is presented in Section 3, and general trends related with waste type are discussed. Cited references are listed in Section 4.

2.0 Shear Strength Measurement Techniques

Ex-tank (laboratory measurements performed on samples removed from the waste tank) and in situ shear strength measurements have been conducted on Hanford sediment. The ex-tank measurement techniques are discussed in Section 2.1, and the in situ measurements are discussed in Section 2.2.

2.1 Ex-tank Shear Strength Measurements

Numerous techniques to determine a material's shear strength have been developed. A review of both direct (direct assessment of the point at which the material yields or starts to flow) and indirect (extrapolation of shear stress-shear rate data to zero shear rate) techniques is presented by Nguyen and Boger (1992). Typical ex-tank measurements at Hanford are made with a shear vane (direct) or Couette type viscometers (indirect). Shear strength estimates have also been made based on horizontal waste core extrusion behavior.

2.1.1 Couette Viscometer

As discussed in the literature (Nguyen and Boger 1983 and 1992, Barnes 1999), Couette viscometer data at low shear rates suffers due to the sensitivity of the instrument and additional shearing and slip caused by the configuration of the instrument. The model assumed (i.e. Bingham, Casson, etc.) for the data can also affect the results (Nguyen and Boger 1992, Chhabra 1992). The data presented in Tingey et al. (2003) demonstrates that, at least for those wastes they considered, the waste has overshoot behavior, resulting in under-prediction of the yield point if the traditional models are applied.

Additionally, as has been noted in the referenced literature and with Hanford sediment (Onishi et al. 2003), sample disturbance history can have a direct impact on the measured shear stress. Aside from sample history prior to introduction into the viscometer, the configuration of the Couette viscometer itself may therefore also preclude the applicability of shear strength estimates from this device to in situ conditions.

2.1.2 Shear Vane

Issues with the Couette type viscometers such as slip and the sensitivity at low rotational speeds may be resolved by the use of a rotating vane device. However, although the instrument sample configuration is more representative of in situ conditions than that of the Couette viscometer, the sample history may still have significant impact on the results. Results of shear vane measurements are typically significantly larger than the in situ shear strength (Gauglitz and Aikin 1997, Heath 1987, Onishi et al. 2003).

2.1.3 Waste Core Extrusion Behavior

Gauglitz and Aikin (1997) developed a methodology to determine the shear stress of waste sediment based on a visual comparison of horizontal waste core extrusion behavior for simulants with known shear strength to that of Hanford Waste. In this document, estimates based on this methodology are termed “visual observations.” Their results generally agreed within a factor of two with the in situ ball rheometer data (see Section 2.2 for a discussion of the ball rheometer).

An “extrusion length” methodology based on the simulant extrusion data of Gauglitz and Aikin (1997) for estimating the yield stress in shear of Hanford Waste was developed in Rassat et al. (2003). This methodology relies on measuring the initial extrusion length of the waste core at plastic failure and produces shear strength values similar in magnitude and with similar trends as the ball rheometer results. It was concluded that, in the absence of definitive in situ measurements, or in support of them, this methodology is expected to produce representative results for the waste shear strength.

Note that although both of the waste core extrusion estimates rely on ex-tank core extrusion behavior, they are as representative of in situ conditions as is available ex-tank. Further, all applicable core segments from a given tank are evaluated, which, given that differences in shear strength have been observed with depth, may provide a more complete data set.

2.2 In Situ Shear Strength Measurements

The ball rheometer was developed to meet the need for measurement of the in situ rheological properties in Hanford double-shell tanks. The rheology of the waste material can be estimated in situ directly from the drag force on a ball as it moves through the waste at various speeds. The ball rheometer results are typically accepted as being more representative of in situ waste conditions than laboratory measurements (Hedengren et al. 2000).

3.0 Hanford Shear Strength Data

Sediments with shear strength measurements considered in this review are grouped into categories similar to those of Barker and Lechelt (2000). These categories include:

- Saltcake waste with ≥ 1 m liquid over solids (SC-LIQ)
- Saltcake waste with < 1 m liquid over solids (SC-NL)
- Sludge waste with ≥ 1 m liquid over solids (SL-LIQ)
- Sludge waste with < 1 m liquid over solids (SL-NL)

Data comparing the various ex-tank and in situ measurements are presented in Table 1. For this general analysis, measurements given are typically average or median values. In some instances, multiple measurements are available throughout the depth and/or at different radial locations in the tank. In others, single measurements are reported. No attempt is made to reconcile these differences, and the average values reported are simple arithmetic averages of the data and do not take into account measurement location, etc. Sample results are chosen as close to in situ waste conditions (i.e. solid volume fraction and temperature) as possible.

As expected (see Section 2), for all waste types with both Couette viscometer and shear vane data, the viscometer results are significantly lower than the shear vane results. For SC-LIQ tanks, the waste core extrusion methodologies compare well with the ball rheometer results, are larger than the viscometer results, and are significantly lower than the shear vane results. In SL-LIQ tanks, where the ball rheometer has not been deployed, the extrusion length results compare favorably with the shear vane results. The extrusion length results are also similar in magnitude to the shear vane values in SL-NL wastes. It is postulated that the shear vane and extrusion results are more similar in sludge than saltcake waste due to solids precipitation in the saltcake samples.

Table 1. Hanford Sediment Measured Shear Strength (Pa), [Reference]

Tank	Waste Type	Measurement Technique				
		Couette Viscometer	Shear Vane	Visual Observation	Extrusion Length	Ball Rheometer
AN-103	SC-LIQ		8,000 [2]	225 [2] ¹	990 [3]	160 [1] ¹
AN-104	SC-LIQ	0.5 [5]			130 [3]	125 [1]
AN-105	SC-LIQ	0.75 [14]				135 [1]
AW-101	SC-LIQ		900 [2]	100 [2]	150 [3]	150 [1]
SY-101 ³	SC-LIQ	60 [15]	290 [15] 730 [8]			
SY-103	SC-LIQ	4 [4]	1,500 [2, 4]	195 [2]	160 [3]	150 [1]
A-101	SC-NL			525 [11]		
S-102	SC-NL			800 [2]		
U-103	SC-NL			885 [11]		
U-107	SC-NL		50 [8]	315 [11]		
AW-103	SL-LIQ		590 [6]			
AY-102	SL-LIQ		510 [6]		1,090 [7]	
AZ-101	SL-LIQ	4.7 [12]	1,770 [6] 1,500 [13]		740 [7]	
AZ-102	SL-LIQ		870 [6]			
AY-101	SL-NL		2,020 [6]			
B-201	SL-NL		1,270 [8]			
B-203	SL-NL	12.3 [9] ²	2,280 [9] 60 [9] ²		1,140 [10]	
B-204	SL-NL				860 [10]	
C-104	SL-NL		850 [6]			
C-107	SL-NL		1,050 [8]			
T-110	SL-NL				1,150 [10]	
T-201	SL-NL				1,770 [10]	
T-202	SL-NL				950 [10]	
T-203	SL-NL	40 [9] ²	3,770 [9] 310 [9] ²		1,030 [10]	
T-204	SL-NL		1,520 [9]		1,090 [10]	

Table References:

[1] Hedengren et al. 2000

[2] Gauglitz and Aikin 1997

[3] Rassat et al. 2003

[4] Bredt PR, JD Hudson, and JM Tingey. 1995. *Effects of Dilution on the Physical, Rheological, and Chemical Properties of Tank 241-SY-103*. Letter Report PNL MIT 092995, Pacific Northwest National Laboratory, Richland, WA.

[5] Herting 1998

[6] Memorandum from DB Bechtold to KE Bell, RA Esch, and FH Steen. *Correction of Shear Strength Measurements Reported by 222-S Laboratory*. March 28, 2001. 8D500-DBB-01-018. Fluor Hanford, Richland, WA.

[7] Analysis performed for W-211 project.

- [8] TWINS, Tank Waste Information System, <http://twins.pnl.gov/>
- [9] Tingey et al. 2003
- [10] Rassat et al. 2003
- [11] Hedengren et al. 2001
- [12] Urie et al. 2002
- [13] Gray et al. 1993
- [14] Herting 1997
- [15] Tingey et al. 1994

¹ Upper portion of sediment layer only

² Diluted sample; results included to illustrate difference in viscometer and shear vane results.

³ SY-101 prior to mixer pump and mitigation.

The most representative shear strength values for in situ waste conditions are obtained with the ball rheometer. For waste processing conditions, other methods may be more appropriate. The accuracy of the extrusion length waste core extrusion methodology in reproducing the ball rheometer results indicates that, in the absence of in situ measurements, this methodology is expected to produce representative results for the waste shear strength. The similarity between the extrusion length and shear vane results in sludge suggest that the shear vane results in sludge waste may be representative of in situ conditions. Therefore, using these guidelines, the following methodology to assign shear strength based on waste type is proposed:

- SC-LIQ, Figure 1, Normal distribution with mean 144 and standard deviation 13.87; data from AN-103, AN-104, AN-105, AW-101, and SY-103, ball rheometer
- SC-NL, Figure 2, Normal distribution with mean 631.25, standard deviation 260.88, and minimum truncated at two standard deviations; data from A-101, S-102, U-103, and U-107, visual observation
- SL-LIQ, Figure 3, Log-normal distribution with mean 829.55 and standard deviation 218.64; data from AW-103 and AZ-102, shear vane; AY-102 and AZ-101, extrusion length
- SL-NL, Figure 4, Log-normal distribution with mean 1,143.27 and standard deviation 272.08; data from AY-101, B-201, C-104, and C-107, shear vane; B-203, B-204, T-110, T-201, T-202, T-203, and T-204, extrusion length

The distributions were determined from the data sources specified. The shear strength values listed in Table 1 have varying degrees of uncertainty. Although the uncertainty in the data is not specifically accounted for, by fitting a distribution to the data, some uncertainty is allowed for. A series of goodness-of-fit tests were conducted using Crystal Ball™ to determine the distribution that best fits the data. Normal and log-normal distributions were preferentially chosen. With the limited amount of data points and their varied pedigree, these distributions should not be interpreted as the true distribution; they are representations of the above listed data.

Differences in shear strength in a given waste type exist, and location in the waste, history, etc. may potentially affect shear strength values. As such, the results presented here should only be used as representative values, and should not be used as substitute for specific analysis of a given waste.

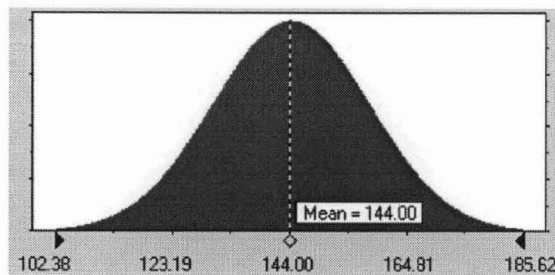


Figure 1. SC-LIQ Shear Strength Distribution (horizontal axis is shear strength (Pa), vertical axis is probability of occurrence)

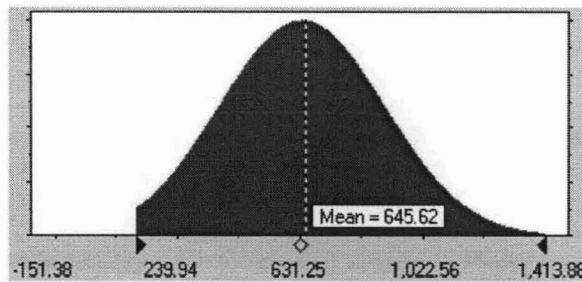


Figure 2. SC-NL Shear Strength Distribution (horizontal axis is shear strength (Pa), vertical axis is probability of occurrence)

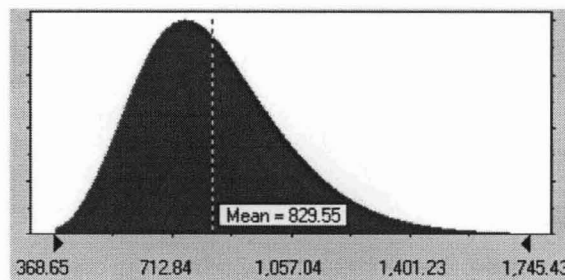


Figure 3. SL-LIQ Shear Strength Distribution (horizontal axis is shear strength (Pa), vertical axis is probability of occurrence)

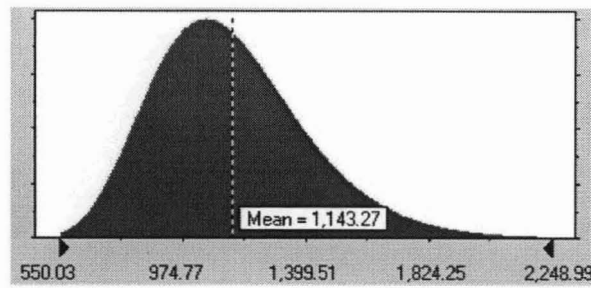


Figure 4. SL-NL Shear Strength Distribution (horizontal axis is shear strength (Pa), vertical axis is probability of occurrence)

4.0 References

- Barker SA and AR Lechelt. 2000. *Determination of Waste Groupings for Safety Analyses*. RPP-6171. Rev. 0. CH2M HILL Hanford Group, Inc., Richland, Washington.
- Barnes HA. 1999. *The Yield Stress - A Review or 'παντα ρει' - Everything Flows?* Journal of Non-Newtonian Fluid Mechanics. 81: 133-178.
- Chhabra RP. 1992. *Bubbles, Drops, and Particles in Non-Newtonian Fluids*. CRC Press, Inc. Boca Raton, FL.
- Gauglitz PA, and JT Aikin. 1997. *Waste Behavior During Horizontal Extrusion: Effect of Waste Strength for Bentonite and Kaolin/Ludox Simulants and Strength Estimates for Wastes from Hanford Waste Tanks 241-SY-103, AW-101, AN-103, and S-102*. PNNL-11706. Pacific Northwest National Laboratory, Richland, WA.
- Gray WJ, ME Peterson, RD Scheele, and JM Tingey. *Characterization of the Second Core Sample of Neutralized Current Acid Waste from Double-Shell Tank 101-AZ*. PNNL-13027. Pacific Northwest National Laboratory, Richland, WA.
- Heath WO. 1987. *Development of an In-Situ Method to Define the Rheological Properties of Slurries and Sludges Stored in Underground Tanks*. PNL-6083. Pacific Northwest Laboratory, Richland, WA.
- Hedengren DC, TA Hu, MA Kufahl, DJ McCain, CW Stewart, JL Huckaby, LA Mahoney, and KG Rappe. 2001. *Data and Observations of Single-Shell Flammable Gas Watch List Tank Behavior*. RPP-7249, Rev. 0. CH2M HILL Hanford Group, Inc., Richland, Washington.
- Hedengren DC, KM Hodgson, WB Barton, CW Stewart, JM Cuta, and BE Wells. 2000. *Data Observations on Double-Shell Flammable Gas Watch List Tank Behavior*. RPP-6655. Rev. 0. CH2M HILL Hanford Group, Inc., Richland, Washington.
- Herting DA. 1998. *Results of Dilution Studies with Waste from Tank 241-AN-104*. HNF-3352, Rev. 0. Fluor Daniel Hanford Inc., Richland, WA.
- Herting DA. 1997. *Results of Dilution Studies with Waste from Tank 241-AN-105*. HNF-SD-WM-DTR-046, Rev. 0. Numatec Hanford Corporation, Richland, WA.
- Nguyen QD, and DV Boger. 1992. *Measuring the Flow Properties of Yield Stress Fluids*. Annual Review of Fluid Mechanics. 24: 47-88.
- Nguyen QD, and DV Boger. 1983. *Yield Stress Measurement for Concentrated Suspensions*. Journal of Rheology. 27 (4): 321-349.

Onishi Y, BE Wells, ST Yokuda, and GT Terrones. 2003. *Feasibility Study on Using a Single Mixer Pump for Tank 241-AN-101 Waste Retrieval*. PNNL-14105. Pacific Northwest National Laboratory, Richland, WA.

Rassat SD, LA Mahoney, BE Wells, DP Mendoza, and DD Caldwell. 2003. *Assessment of Physical Properties of Transuranic Waste in Hanford Single-Shell Tanks*. PNNL-14221. Pacific Northwest National Laboratory, Richland, WA.

Tingey JM, J Gao, CH Delegrad, LM Bagaason, and BE Wells. 2003. *Physical Property and Rheological Testing of Actual Transuranic Waste from Hanford Single-Shell Tanks*. PNNL-14365. Pacific Northwest National Laboratory, Richland, WA.

Tingey JM, PR Bredt, and EH Shade. 1993. *The Effects of Heating and Dilution on the Rheological and Physical Properties of Tank 241-SY-101 Waste*. PNL-10198. Pacific Northwest Laboratory, Richland, WA.

Urie MW, PR BRedt, JA Campbell, OT Farmer, SK Fiskum, LR Greenwood, EW Hoppe, LK Jagoda, GM Mong, AP Poloski, RD Scheele, CZ Soderquist, RG Swoboda, MP Thomas, and JJ Wagner. 2002. *Chemical Analysis and Physical Property Testing of 241-AZ-101 Tank Waste - Supernatant and Centrifuged Solids*. PNWD-3215. Battelle, Richland, WA.

This page intentionally left blank.

APPENDIX G

DERIVATION OF RETAINED GAS COMPOSITIONS

This page intentionally left blank

CONTENTS

G1.0	INTRODUCTION	G-1
G1.1	OBJECTIVES.....	G-1
G1.2	DISTRIBUTIONS REQUIRED TO DETERMINE THE RETAINED GAS COMPOSITIONS.....	G-1
G2.0	CALCULATION PROCEDURE	G-2
G2.1	SCAN IN RGS DATA TABLES	G-3
G2.2	COMBINE PAIRED DISTRIBUTIONS	G-3
G2.3	CREATE DISTRIBUTIONS FOR RGS TANKS.....	G-28
G2.4	CREATE DISTRIBUTIONS FOR NON-RGS TANKS.....	G-49
G2.5	REFORMAT RESULTS TO FIT DATABASE	G-52
G3.0	RESULTS	G-53
G4.0	REFERENCES	G-56

FIGURES


Figure G.3.1.	Distribution fit of CH ₄ Ratio	G-55
Figure G.3.2.	Distribution fit of N ₂ O Ratio	G-55
Figure G.3.3.	Distribution fit of N ₂ Concentration.....	G-55

TABLES

Table G.3.1.	Retained Gas Concentration Distribution Results	G-53
--------------	---	------

Calculation Reviewed: Appendix J -- Derivation Of Retained Gas Compositions, RPP-10006 Rev 4, Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site

Scope of Review: Appendix J (See also Spreadsheet Verification 271)
(e.g., document section or portion of calculation)

Engineer/Analyst: S. A. Barker  Date: 10/27/2004

Organizational Mgr: T. M. Horner  Date: 10/27/2004

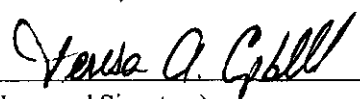
This document consists of 60 pages and the following attachments (if applicable):

Yes No NA*

- | | | | |
|-------------------------------------|--------------------------|--------------------------|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1. Analytical and technical approaches and results are reasonable and appropriate. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2. Necessary assumptions are reasonable, explicitly stated, and supported. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3. Ensure calculations that use software include a paper printout, microfiche, CD ROM, or other electronic file of the input data and identification to the computer codes and versions used, or provide alternate documentation to uniquely and clearly identify the exact coding and execution process. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4. Input data were checked for consistency with original source information. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. For both qualitative and quantitative data, uncertainties are recognized and discussed. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 6. Mathematical derivations were checked including dimensional consistency of results. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 7. Calculations are sufficiently detailed such that a technically qualified person can understand the analysis without requiring outside information. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 8. Software verification and validation are addressed adequately. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 9. Limits/criteria/guidelines applied to the analysis results are appropriate and referenced. Limits/criteria/guidelines were checked against references. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10. Conclusions are consistent with analytical results and applicable limits. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 11. Results and conclusions address all points in the purpose. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 12. Referenced documents are retrievable or otherwise available. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 13. The version or revision of each reference is cited. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 14. The document was prepared in accordance with Attachment A, "Calculation Format and Preparation Instructions." |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 15. Impacts on requirements have been assessed and change documentation initiated to incorporate revisions to affected documents as appropriate. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 16. All checker comments have been dispositioned and the design media matches the calculations. |

T. A. Campbell

Checker (Printed Name and Signature)

 10/27/2004

Date

* If No or NA is chosen, an explanation must be provided on or attached to this form.

APPENDIX G

DERIVATION OF RETAINED GAS COMPOSITIONS

G1.0 INTRODUCTION

This report provides the documentation for the derivation of the retained gas composition parameters. The major components for of the flammable gases generated within the Hanford wastes are hydrogen (H_2), nitrogen (N_2), methane (CH_4), ammonia (NH_3), and nitrous oxide (N_2O). The values for these compositions within a tank are quite variable and are best expressed as a distribution. In order to constrain the compositions in the gas phase during the Monte Carlo simulation, the concentration of N_2O and CH_4 are expressed as ratios with H_2 , and the H_2 concentration is determined by difference. The retained gas composition is required in the determination of the waste groupings described in the document. This gas composition determined the flammability of the headspace following a release of retained gas.

G1.1 OBJECTIVES

The objective of this appendix is to use the available Retained Gas Sampler (RGS) data for 16 tanks to derive the distributions required to predict the gas composition for the 16 sampled tanks and to prepare default retained gas composition distributions for tanks that have not been sampled.

G1.2 DISTRIBUTIONS REQUIRED TO DETERMINE THE RETAINED GAS COMPOSITIONS.

In order to determine the total retained gas composition, the concentration of the five gases, which make up the retained gas must be estimated. These gases are H_2 , N_2 , CH_4 , NH_3 , and N_2O . A Monte Carlo simulation picking random values from the individual gas compositions without constraints will rarely pick a set of five concentrations that would add up to exactly 100%. In order to constrain the Monte Carlo, the following method for determining the retained gas composition has been developed. The concentrations of N_2 and NH_3 are determined directly. The compositions for the CH_4 and N_2O gases are described as ratios to the hydrogen concentrations. Equations 1 through 7 describe these ratios and an example solution to the retained gas concentrations is presented.

Given:

Retained gas
concentration of
 N_2 = $[N_2] = 29.2\%$

Retained gas
concentration of
 NH_3 = $[NH_3] = 0.079\%$

$$\text{CH}_4 \text{ gas ratio} = [\text{CH}_4] / \{[\text{CH}_4] + [\text{H}_2]\} \quad (\text{Equation 1})$$

$$\text{CH}_{4\text{ratio_rg}} = 0.114$$

$$\text{N}_2\text{O gas ratio} = [\text{N}_2\text{O}] / \{[\text{CH}_4] + [\text{H}_2] + [\text{N}_2\text{O}]\} \quad (\text{Equation 2})$$

$$\text{N}_{2\text{Oratio_rg}} = 0.271$$

The CH_4 term is defined as

$$t_{\text{CH}_4} = \frac{\text{CH}_{4\text{ratio_rg}}}{1 - \text{CH}_{4\text{ratio_rg}}} \quad (\text{Equation 3})$$

$$t_{\text{CH}_4} = 0.1287$$

The N_2O term is defined as

$$t_{\text{N}_2\text{O}} = \frac{\text{N}_{2\text{Oratio_rg}}}{1 - \text{N}_{2\text{Oratio_rg}}} \quad (\text{Equation 4})$$

$$t_{\text{N}_2\text{O}} = 0.3717$$

The H_2 concentration is calculated from the equation

$$[\text{H}_2] = \frac{1 - ([\text{NH}_3] + [\text{N}_2])}{1 + t_{\text{CH}_4} + t_{\text{CH}_4} * t_{\text{N}_2\text{O}} + t_{\text{N}_2\text{O}}} \quad (\text{Equation 5})$$

$$[\text{H}_2] = 45.68\%$$

The CH_4 concentration is calculated from the equation

$$[\text{CH}_4] = [\text{H}_2] * t_{\text{CH}_4} \quad (\text{Equation 6})$$

$$[\text{CH}_4] = 5.88\%$$

And finally the N_2O concentration is calculated from the equation

$$[\text{N}_2\text{O}] = ([\text{H}_2] + [\text{CH}_4]) * t_{\text{N}_2\text{O}} \quad (\text{Equation 7})$$

$$[\text{N}_2\text{O}] = 19.17\%$$

G2.0 CALCULATION PROCEDURE

The process for calculating the retained gas compositions is outlined in the following procedure. The retained gas composition is based on the RGS results published in PNNL-13317, "Ammonia Results Review for Retained Gas Sampling". This procedure begins with scanned in images of Table 2.3 of PNNL-13317.

All calculations are done in EXCEL¹ with the Crystal Ball² Monte Carlo add-in.

G2.1 SCAN IN RGS DATA TABLES

Spreadsheet “rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “1-Major Components”

1. Scan Data into digital format from document and proofread.

Tab “2-Minor comps”

Scan unpublished data on minor component compositions and proofread. The minor components are often listed in the tables as “other”. This breakdown allows the approximately 3% of the gases listed as other to be broken down and assigned to the appropriate gas. In this case CH_x hydrocarbons are assigned to methane (CH₄) and nitrous oxides (NO_x) are assigned to nitrogen (N₂).

G2.2 COMBINE PAIRED DISTRIBUTIONS

Combine Paired Distributions for High and Low Salt Conditions to Make a Single Distribution

Assume that a combined stepwise distribution adequately describes combination of high and low salt compositions.

Tab “3-revised comps”

1. Copy values from Tabs 1 and 2 and paste and transpose into appropriate column “C” cells.

Combine Distributions for All Tanks Except for SY-101

2. Create Crystal Ball assumption for components listed below with mean and standard deviation data in Columns “D” and “H.”

H₂, N₂, N₂O, CH₄, NH₃, C₂H_x, C₃H_x, Other HC , Other NO_x

¹ EXCEL is a trademark of Microsoft Corporation, Redmond, Washington.

² Crystal Ball is a trademark of Decisioneering, Inc, Denver, Colorado.

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “1-Major Components”

Tank and Sample (or Layer)	Mole Percent of Constituent in Bubbles						Gas Volume Percent	Elevation (cm, in.)
	H2	N2	N2O	CH4	NH3	Other		
AW-101-24A-8	26±9.4 to 24±8.8	68±32 to 70±34	1.8±0.7 to 0.5±0.2	1.0±0.4	0.4±0.2	3.0±1.4 to 3.6±1.6	0.8±0.1 to 0.7±0.1	700, 276.5
AW-101-24A-17	29±3.9	58±8.9 to 62±9.3	5.5±0.9 to 2.9±0.4	1.8±0.3	0.6±0.3	3.4±0.6 to 3.6±0.6	2.7±0.3 to 2.5±0.3	265, 104.5
AW-101-24B-18	19±3.1	68±14 to 71±14	6.7±1.2 to 3.2±0.6	2.0±0.4	0.3±0.1	4.2±0.7 to 4.6±0.8	2.1±0.4 to 1.9±0.4	217, 86.5
AW-101-24A-19	43±3.5 to 44±3.6	47±4.1 to 48±4.1	5.7±0.5 to 3.9±0.3	1.4±0.1	0.8±0.4	1.9±0.2 to 2.0±0.2	5.2±0.5 to 5.0±0.5	169, 66.5
AW-101-24A-21	30±2.5 to 31±2.6	57±4.8 to 59±5.0	8.0±0.7 to 5.3±0.5	1.8±0.3	0.7±0.3	2.5±0.3 to 2.6±0.3	5.1±0.5 to 4.8±0.5	72.3, 36.5
AW-101-24B-22	13±2.1 to 14±2.1	67±11 to 72±12	12±2.0 to 5.2±0.9	2.2±0.4 to 2.3±0.5	0.3±0.1	5.3±1.3 to 6.0±1.4	2.0±0.4 to 1.8±0.4	24.1, 9.5
AW-101 - C(b)	26±9.4 to 24±8.8	68±32 to 70±34	1.8±0.7 to 0.5±0.2	1.0±0.4	0.4±0.2	3.0±1.4 to 3.6±1.6	0.8±0.3 to 0.7±0.3	673, 265
AW-101 - NC(b)	32±3.2 to 33±3.2	56±6.2 to 58±6.4	7.2±0.8 to 4.4±0.5	1.7±0.2	0.6±0.3	3.0±0.5 to 3.2±0.5	3.7±1.8 to 3.5±1.8	131, 51.6
A-101-24-2	63±5.5 to 64±5.6	26±4.9 to 27±4.9	7.4±0.7 to 6.5±0.6	0.4±0.1	2.1±1.0	0.5±0.07	16±1.4	845, 332.5
A-101-15-5	75±8.1	15±4.8	5.7±0.6 to 5.2±0.6	0.7±0.1	3.5±1.2	0.3±0.06	18±2.1	700, 275.5
A-101-15-8	76±7.8	16±5.4	5.3±0.6 to 5.0±0.5	0.7±0.08	2.0±0.6	0.3±0.04	20±2.1	555, 218.5
A-101-24-9	70±6.1	23±4.6	4.9±0.4 to 4.5±0.4	0.8±0.09	1.7±0.3	0.2±0.03	22±2.1 to 21±2.1	507, 199.5
A-101-15-12	12±4.4	63±29 to 73±34	15±6.7 to 4.9±2.2	3.1±1.7 to 3.2±1.6	3.7±1.9	2.6±1.4 to 3.6±1.9	0.7±0.3 to 0.5±0.3	362, 142.5
A-101-24-16	15±4.2 to 14±4.0	64±20 to 74±24	14±4.4 to 4.1±1.3	0.9±0.3	3.7±1.8	2.2±0.9 to 3.0±1.3	0.6±0.3 to 0.5±0.3	189, 66.5
A-101-24-19	18±4.5	65±20 to 72±23	12±3.4 to 4.2±1.2	0.7±0.2	3.3±1.6	1.3±0.5 to 1.6±0.7	1.0±0.3 to 0.8±0.3	24.1, 9.5
A-101 - NC	72±7.1	19±4.9	5.8±0.6 to 5.3±0.5	0.7±0.1	2.5±0.9	0.3±0.05	18±6.0	841, 252
A-101 - C	15±4.5	64±24 to 73±27	14±4.9 to 4.4±1.6	1.7±0.8	3.5±1.8	2.1±0.9 to 2.8±1.3	0.7±0.3 to 0.6±0.3	186, 73
AN-105-7B-4	25±12 to 24±12	58±42 to 66±49	11±5.6 to 3.4±1.8	1.4±0.9	0.6±0.4	3.2±1.4 to 4.3±2.0	0.7±0.3 to 0.5±0.3	893, 351.5
AN-105-12A-15	20±14 to 18±14	64±64 to 73±73	11±6.1 to 3.1±2.4	1.4±1.1	0.4±0.4	3.0±1.7 to 4.4±2.7	0.5±0.2 to 0.3±0.2	362, 142.5
AN-105-7B-16	19±5.9 to 17±5.6	71±28 to 77±31	7.1±2.6 to 2.1±0.8	0.8±0.4	0.3±0.2	2.1±0.9 to 2.7±1.1	0.7±0.2 to 0.5±0.2	314, 123.5
AN-105-12A-17	65±5.2 to 67±5.3	22±2.0 to 23±2.1	11±1.0 to 7.9±0.7	0.6±0.1	0.6±0.3	0.7±0.1	6.9±0.7 to 6.5±0.7	265, 104.5
AN-105-7B-18	55±7.8 to 57±8.1	31±5.0 to 33±5.3	11±1.9 to 6.3±1.1	0.8±0.2	0.5±0.2	1.7±0.5 to 1.8±0.6	2.7±0.4 to 2.4±0.4	217, 85.5
AN-105-12A-19	65±4.9 to 66±5.0	21±3.4 to 22±3.5	12±1.0 to 10±0.8	0.6±0.06	0.5±0.2	0.4±0.1	12±0.8	189, 66.5
AN-105-12A-21	57±4.0 to 60±4.2	22±1.6 to 24±1.7	19±1.5 to 14±1.2	0.8±0.06	0.3±0.2	0.5±0.1	7.4±0.7 to 6.9±0.7	72.4, 28.5
AN-105 - C	25±12 to 24±12	58±42 to 66±49	11±5.6 to 3.4±1.8	1.4±0.9	0.6±0.4	3.2±1.4 to 4.3±2.0	0.5±0.2 to 0.4±0.2	608, 239
AN-105 - NC	60±5.4 to 62±5.5	24±4.0 to 25±3.9	14±1.5 to 11±1.1	0.7±0.09	0.5±0.2	0.6±0.1	5.1±2.6 to 4.8±2.4	136, 53
High composition error bands result from a combination of relatively small amounts of sample gas and large amounts of air contamination.								
The ± values represent the measurement error band. The two central values are, first, the one based on the highest salt effect on gas solubility (lower-bound solubility); second, the one based on the lowest salt effect on gas solubility (upper-bound solubility). Only one central value is given in cases where gas solubility has too little effect to show up in the significant figures.								
Tank and Sample (or Layer)	Mole Percent of Constituent	Gas Volume Percent	Elevation (cm, in.)					
	H2	N2	N2O	CH4	NH3	Other		
AN-104-10A-3	25±13	56±49 to 65±58	14±7.6 to 4.0±2.4	1.9±1.3	0.8±0.5	2.6±1.4 to 3.5±1.9	0.9±0.3 to 0.7±0.3	893, 351.5
AN-104-10A-13	41±8.2 to 44±8.6	41±9.7 to 45±11	14±3.7 to 6.7±1.8	1.3±0.5 to 1.4±0.5	0.4±0.2	1.9±0.7 to 2.2±0.8	2.2±0.4 to 1.9±0.4	410, 161.5
AN-104-10A-15	50±8.1 to 52±8.4	32±5.7 to 34±6.0	13±2.5 to 8.8±1.6	1.1±0.3 to 1.2±0.3	1.9±0.9	1.3±0.4 to 1.4±0.5	4.7±0.8 to 4.4±0.8	314, 123.5
AN-104-10A-17	29±6.0 to 30±6.3	53±13 to 55±14	14±3.1 to 10±2.2	1.5±0.3 to 1.6±0.4	0.7±0.3	1.6±0.4 to 1.7±0.4	5.7±0.8 to 5.3±0.8	217, 85.5
AN-104-12A-18	45±3.6 to 47±3.8	37±3.0 to 38±3.2	15±1.5 to 12±1.1	1.1±0.2	0.5±0.2	1.4±0.4 to 1.5±0.4	7.1±0.7 to 6.7±0.7	169, 66.5
AN-104-10A-21	47±7.8 to 49±8.1	21±3.5 to 22±3.6	30±5.1 to 27±4.6	0.6±0.1	0.9±0.4	0.3±0.07	17±1.9 to 16±1.9	24.1, 9.5
AN-104 - C	25±13	56±49 to 65±58	14±7.6 to 4.0±2.4	1.9±1.3	0.8±0.5	2.6±1.4 to 3.5±1.9	0.5±0.2 to 0.4±0.2	895, 274
AN-104 - NC	45±6.9 to 47±7.1	29±4.8 to 31±5.1	23±3.7 to 20±3.2	0.9±0.2	0.9±0.4	0.8±0.2 to 0.9±0.2	8.0±4.0 to 7.5±3.8	115, 45
AN-103-12A-2	62±6.4 to 63±6.4	29±3.2	6.9±0.7 to 6.0±0.6	0.6±0.07	1.4±0.6	0.25±0.04	16±1.4	845, 332.5
AN-103-12A-5	19±10 to 18±10	69±54 to 75±60	7.9±4.7 to 2.3±1.4	1.7±1.3	1.0±0.7	1.4±0.7 to 1.7±0.8	0.8±0.3 to 0.6±0.3	700, 275.5
AN-103-21A-10	20±13 to 18±13	70±70 to 76±76	7.0±4.8 to 1.8±1.3	1.2±0.9 to 1.1±0.9	0.8±0.6	1.4±0.7 to 1.8±0.9	0.6±0.3 to 0.5±0.3	458, 180.5
AN-103-12A-14	55±8.8	38±6.5 to 39±6.8	4.9±0.8 to 3.8±0.6	0.7±0.2	0.7±0.3	0.4±0.1	6.7±1.2 to 6.5±1.2	265, 104.5
AN-103-21A-16	64±7.2	30±3.5 to 31±3.5	3.8±0.4 to 3.3±0.4	0.6±0.1	0.6±0.2	0.4±0.09	12±1.5	169, 66.5
AN-103 crust	62±6.4 to 63±6.4	29±3.2	6.9±0.7 to 6.0±0.6	0.6±0.07	1.4±0.6	0.2±0.03	16±7.9	838, 330

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “1-Major Components”

Tank and Sample (or Layer)	Mole Percent of Constituent in Bubbles						Gas Volume Percent	Elevation (cm, in.)
	H2	N2	N2O	CH4	NH3	Other		
AN-103 - C	19±12 to 18±12	70±82 to 76±69	7.5±4.8 to 2.1±1.4	1.4±1.1	0.9±0.6	1.4±0.6 to 1.7±0.8	0.7±0.3 to 0.6±0.3	586, 231
AN-103 - NC	61±7.7 to 62±7.7	33±4.3	4.1±0.6 to 3.4±0.5	0.6±0.1	0.6±0.2	0.4±0.09	9.2±4.6 to 9.0±4.5	160, 63
U-103-7-2	23±1.3	36±2.1 to 37±2.1	40±2.1 to 39±2.1	0.4±0.03	0.13±0.04 to 0.07±0.02	0.5±0.05	42±2.6 to 41±2.6	362, 142.5
U-103-7-5	14±0.9 to 16±1.0	32±2.0 to 36±2.2	51±3.1 to 46±2.8	0.26±0.06	1.6±0.6	0.4±0.1	9.6±0.8 to 8.5±0.8	217, 85.5
U-103-7-7	24±1.5 to 25±1.6	41±2.6 to 44±2.8	32±1.9 to 28±1.7	0.6±0.1	1.1±0.3	1.0±0.1 to 1.1±0.1	11±1.2 to 10±1.2	121, 47.5
U-103-7-8	31±3.1 to 33±3.3	36±3.6 to 39±3.9	29±2.9 to 24±2.4	0.8±0.1	1.1±0.6	1.7±0.2 to 1.8±0.2	7.8±1.0 to 7.1±1.0	72, 28.5
U-103 - NC	23±1.4 to 24±1.5	36±2.3 to 38±2.4	39±2.4 to 37±2.2	0.4±0.05	0.6±0.3 to 0.5±0.2	0.7±0.08	19±9.5 to 18±9.0	277, 109
S-106-7-3	59±5.0 to 60±5.1	32±3.1 to 33±3.2	7.8±0.7 to 5.9±0.5	0.4±0.2	0.3±0.2	0.2±0.1	9.6±0.9 to 9.3±0.9	362, 142.5
S-106-7-5	62±5.5 to 65±5.7	23±3.6	14±1.2 to 11±1.0	0.01±0.01	0.3±0.1	0.5±0.2 to 0.6±0.2	10±1.0	265, 104.5
S-106-8-6	63±8.6 to 65±8.8	25±3.6 to 26±3.7	9.9±1.5 to 7.2±1.1	0.5±0.2	0.5±0.3	0.9±0.5 to 1.0±0.5	7.6±0.8 to 7.3±0.8	217, 85.5
S-106-8-10	65±4.9 to 66±5.1	23±4.2 to 24±4.3	11±0.8 to 9.0±0.7	0.2±0.02	0.2±0.1	0.4±0.2	14±1.2	24, 9.5
S-106 - NC	63±5.7 to 65±5.9	25±3.7 to 26±3.8	11±1.0 to 8.4±0.8	0.3±0.08	0.3±0.2	0.5±0.2	10±5.0	151, 59.5
High composition error bands result from a combination of relatively small amounts of sample gas and large amounts of air contamination.								
The ± values represent the measurement error band. The two central values are, first, the one based on the highest salt effect on gas solubility (lower-bound solubility); second, the one based on the lowest salt effect on gas solubility (upper-bound solubility). Only one central value is given in cases where gas solubility has too little effect to show up in the significant figures.								
Tank and Sample (or Layer)	Mole Percent of Constituent	Gas Volume Percent	Elevation (cm, in.)					
	H2	N2	N2O	CH4	NH3	Other		
BY-109-12C-4	35±3.6 to 36±3.8	40±7.9 to 42±8.3	21±2.2 to 18±1.9	1.0±0.2	0.3±0.2	2.2±0.3 to 2.3±0.3	6.3±0.4 to 6.1±0.4	121, 47.5
BY-109-10B-5	52±5.5 to 53±5.6	29±5.0	16±1.7 to 15±1.6	0.7±0.1	0.2±0.1	1.8±0.3	8.7±0.8 to 8.4±0.8	121, 47.5
BY-109-10B-6	56±6.4 to 57±6.5	23±3.8	17±3.3 to 16±3.1	0.9±0.1	0.2±0.1	2.6±0.4 to 2.7±0.4	12±1.0	72, 28.5
BY-109 below ILL	50±5.5 to 51±5.6	29±5.1	18±2.5 to 16±2.3	0.9±0.1	0.2±0.1	2.3±0.3	9.4±4.7 to 9.2±4.6	120, 47
SX-106-3-2	22±2.9 to 15±2.4	63±11 to 74±14	11±1.5 to 1.7±0.3	1.4±0.5 to 1.0±0.4	1.0±0.2 to 0.4±0.1	1.9±0.7 to 7.7±2.9	0.1±0.04 to 0.03±0.03	458, 180.5
SX-106-3-4	19±6.1 to 16±5.1	65±28 to 78±34	13±4.8 to 2.2±0.8	0.9±0.4 to 0.7±0.3	0.8±0.3 to 0.4±0.1	1.0±0.4 to 2.5±0.9	0.2±0.07 to 0.07±0.07	362, 142.5
SX-106-6-6	50±5.0 to 53±5.4	23±3.3 to 25±3.5	18±1.9 to 16±1.7	1.9±0.3 to 2.0±0.3	6.7±0.8 to 3.0±0.4	1.0±0.3 to 1.1±0.3	9.1±1.0 to 8.4±1.0	265, 104.5
SX-106-6-6A	51±5.6 to 56±6.2	19±3.3 to 21±3.7	22±2.9 to 17±2.2	2.7±0.9 to 3.0±1.0	4.0±0.5 to 1.8±0.2	1.4±0.4 to 1.6±0.4	4.1±0.8 to 3.6±0.6	265, 104.5
SX-106-3-7	48±8.5 to 50±8.5	19±8.6 to 20±9.0	27±7.1	0.5±0.09	5.7±2.7 to 2.5±1.2	0.3±0.08	30±11 to 29±11	217, 85.5
SX-106-6-9	60±3.6 to 62±3.6	17±2.0 to 18±2.0	17±1.1	0.4±0.1	4.9±0.8 to 2.2±0.3	0.3±0.09	36±2.2 to 34±2.2	121, 47.5
SX-106-3-10	44±2.8 to 47±2.7	21±2.4 to 22±2.5	28±1.8	0.6±0.05	5.5±0.8 to 2.4±0.4	0.3±0.08	32±2.0 to 31±2.0	72, 28.5
SX-106-C	21±4.9 to 16±4.0	64±21 to 77±26	12±3.4 to 2.1±0.6	1.1±0.4 to 0.8±0.4	0.9±0.2 to 0.4±0.1	1.4±0.5 to 3.9±1.4	0.2±0.1 to 0.05±0.05	418, 164
SX-106 - NC	50±4.5 to 52±4.5	20±3.8 to 21±4.0	24±2.8 to 24±2.7	0.6±0.1	5.5±1.2 to 2.4±0.5	0.3±0.08	26±13 to 25±13	136, 53
AX-101-9D-8	61±5.5 to 64±5.5	17±2.6 to 18±2.7	11±1.0	2.4±0.2 to 2.5±0.2	8.4±1.9 to 4.3±1.0	0.7±0.2	17±1.3 to 16±1.3	362, 142.5
S-102-16-2	36±2.5 to 37±2.5	37±4.4 to 38±4.4	26±1.8 to 24±1.7	0.4±0.05	0.6±0.4 to 0.4±0.2	0.1±0.02	33±4.3 to 32±4.3	458, 180.5
S-102-16 4R	33±2.9 to 37±3.2	31±4.1 to 36±4.7	34±3.4 to 26±2.5	0.2±0.07 to 0.3±0.08	1.3±0.9 to 0.7±0.5	0.3±0.09	7.4±0.7 to 6.4±0.7	362, 142.5
S-102-16-7	27±3.1 to 28±3.2	29±4.2 to 30±4.4	42±4.8 to 41±4.6	0.4±0.06	1.5±0.4 to 0.8±0.2	0.07±0.03	30±1.9 to 29±1.9	217, 85.5
S-102-16-10	43±3.8 to 46±4.1	29±4.3 to 31±4.6	25±2.2 to 21±1.9	0.7±0.08 to 0.8±0.08	1.2±0.3 to 0.6±0.2	0.6±0.1	12±1.1 to 11±1.1	72, 28.5
S-102 tank avg.	33±3.0 to 35±3.1	32±4.3 to 33±4.5	33±3.1 to 31±2.9	0.4±0.06 to 0.5±0.06	1.1±0.4 to 0.6±0.2	0.2±0.04	26±13 to 25±13	292, 115
S-111-6-2	6.3±3.4 to 5.8±3.2	90±68 to 92±70	1.7±1.0 to 0.7±0.4	0.3±0.2	0.2±0.2 to 0.1±0.1	1.0±0.8 to 1.2±0.9	0.8±0.2 to 0.7±0.2	458, 180.5
S-111-6-4	48±24 to 51±25	36±22 to 38±23	14±5.5 to 9.8±4.0	0.6±0.2	0.9±0.4 to 0.5±0.2	0.3±0.08	6.9±2.1 to 6.5±2.1	362, 142.5
S-111-6-6	58±5.1 to 60±5.2	26±3.4 to 27±3.5	14±1.3 to 11±1.1	0.8±0.1	1.2±0.4 to 0.7±0.2	0.5±0.2	15±5	265, 104.5
S-111-6-8	67±7.1 to 68±7.2	20±2.8	12±1.3 to 11±1.2	0.6±0.08	0.7±0.2 to 0.4±0.1	0.2±0.07	20±2.8 to 20±2.9	169, 66.5
S-111-6-10	73±5.6 to 74±5.7	16±2.0 to 18±2.0	9.2±0.8 to 8.5±0.7	0.3±0.04	1.6±0.4 to 0.9±0.3	0.09±0.04	23±3.2 to 22±3.2	72, 28.5

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “1-Major Components”

Tank and Sample (or Layer)	Mole Percent of Constituent in Bubbles						Gas Volume Percent	Elevation (cm, in.)
	H2	N2	N2O	CH4	NH3	Other		
S-111 - C	6.3±3.4 to 5.8±3.2	90±68 to 92±70	1.7±1.0 to 0.7±0.4	0.3±0.2	0.2±0.2 to 0.1±0.1	1.0±0.8 to 1.2±0.9	0.8±0.2 to 0.7±0.2	439, 173
S-111 - NC	66±10 to 67±11	21±5.6 to 22±5.8	11±1.7 to 9.6±1.5	0.5±0.08	1.1±0.4 to 0.6±0.2	0.2±0.05	15±7.5 to 14±7.0	139, 55
High composition error bands result from a combination of relatively small amounts of sample gas and large amounts of air contamination.								
The ± values represent the measurement error band. The two central values are, first, the one based on the highest salt effect on gas solubility (lower-bound solubility); second, the one based on the lowest salt effect on gas solubility (upper-bound solubility). Only one central value is given in cases where gas solubility has too little effect to show up in the significant figures.								
Tank and Sample (or Layer)	Mole Percent of Constituent						Gas Volume Percent	Elevation (cm, in.)
	H2	N2	N2O	CH4	NH3	Other		
U-109-8-2	20±2.9 to 21±3.1	42±7.6 to 45±8.0	3616.3 to 33±5.7	0.5±0.1 to 0.6±0.09	0.8±0.3 to 0.41±0.2	0.4±0.2	20±2.5 to 19±2.5	362, 142.5
U-109-8-4	24±3.2 to 25±3.3	38±6.3 to 40±6.6	35±4.0 to 33±3.7	0.6±0.08	2.2±0.9 to 1.2±0.5	0.3±0.07	23±2.2 to 22±2.2	265, 104.5
U-109-8-6	28±5.0 to 30±5.2	43±11 to 45±11	26±5.1 to 23±4.4	1.1±0.2 to 1.2±0.2	1.0±0.3 to 0.5±0.2	0.7±0.2	15±1.0 to 14±1.0	169, 66.5
U-109-8-8	27±2.4 to 28±2.5	52±7.5 to 53±7.7	19±1.7 to 17±1.6	0.8±0.9	1.10±4 to 0.5±0.2	0.4±0.07	30±1.9 to 29±1.8	72, 28.5
U-109 - NC	25±3.1 to 26±3.2	46±7.8 to 48±8.1	27±3.5 to 24±3.2	0.7±0.1 to 0.8±0.1	1.2±0.5 to 0.6±0.2	0.4±0.1	22±11 to 21±10	204, 80
SY-101-23A-1	22±3.2 to 23±3.3	47±9.4 to 51±10	23±3.4 to 21±3.1	0.8±0.1 to 0.9±0.1	6.2±1.8 to 2.9±0.8	0.7±0.1 to 0.8±0.1	20±1.5 to 18±1.5	1022, 402
SY-101-23A-2	34±4.8 to 38±5.1	27±4.5 to 30±4.8	21±3.0 to 23±3.0	0.6±0.09	16±3.7 to 7.1±1.6	0.9±0.3 to 1.0±0.3	39±2.9 to 35±2.9	974, 383.5
SY-101-22A-3	34±4.4 to 37±4.6	30±4.9 to 33±5.2	24±3.3 to 24±3.2	0.8±0.2 to 0.7±0.2	11±2.6 to 5.0±1.2	0.4±0.2 to 0.5±0.2	33±2.7 to 30±2.7	959, 377.5
SY-101-23A-3	40±4.4 to 45±4.4	23±3.3 to 26±3.4	18±1.9 to 20±1.8	0.5±0.07 to 0.6±0.07	18±4.7 to 7.6±1.9	0.5±0.09 to 0.6±0.1	61±3.9 to 53±3.9	926, 364.5
SY-101-22A-4	35±3.9 to 44±3.6	21±3.2 to 26±3.4	17±1.8 to 20±1.6	0.5±0.08 to 0.7±0.08	26±6.8 to 8.6±2.1	0.5±0.08	73±7 to 58±3.8	911, 358.5
SY-101-4A-5	38±8.7 to 43±10	27±7.9 to 33±9.4	24±6.1 to 17±4.3	1.1±0.3 to 1.2±0.4	8.8±2.4 to 4.2±1.1	1.1±0.4 to 1.3±0.4	6.0±1.8 to 4.9±1.7	845, 332.5
SY-101-23A-8	24±6.6 to 27±7.5	46±14 to 55±17	21±6.3 to 12±3.5	1.4±0.5 to 1.6±0.6	5.9±1.0 to 2.8±0.8	1.4±0.6 to 1.7±0.7	3.5±1.2 to 2.8±1.2	685, 269.5
SY-101-22A-10	29±10 to 35±12	35±14 to 44±17	25±8.7 to 14±4.7	1.4±0.5 to 1.7±0.6	8.0±2.7 to 3.8±1.3	1.4±0.5 to 1.8±0.6	3.2±1.1 to 2.4±1.0	621, 244.5
SY-101-23A-13	29±9.9 to 34±12	37±14 to 46±18	25±8.6 to 13±4.4	1.2±0.4 to 1.4±0.5	6.7±1.5 to 3.2±1.2	1.5±0.6 to 2.0±0.8	2.8±0.9 to 2.1±0.9	443, 174.5
SY-101-22A-17	30±7.5 to 36±9.2	35±11 to 45±14	27±7.0 to 13±3.5	1.5±0.4 to 1.8±0.5	4.8±0.9 to 2.3±0.7	1.3±0.4 to 1.7±0.6	2.5±0.7 to 1.8±0.7	316, 124.5
SY-101-23A-21	29±8.8 to 34±10	40±13 to 49±17	23±6.9 to 11±3.2	1.6±0.5 to 1.8±0.6	4.8±0.9 to 2.2±0.7	1.4±0.5 to 1.9±0.6	2.3±0.7 to 1.7±0.7	75, 29.5
SY-101-22A-23	32±8.7 to 38±10	36±12 to 45±15	26±7.6 to 12±3.6	1.3±0.4 to 1.6±0.5	4.0±0.6 to 1.9±0.6	1.2±0.4 to 1.7±0.6	2.5±0.8 to 1.9±0.8	28, 11
SY-101-23A crust	35±4.4 to 39±4.5	28±4.6 to 32±4.9	20±2.5 to 21±2.4	0.6±0.09	16±3.9 to 6.7±1.6	0.7±0.2	40±20 to 35±18	953, 375
SY-101-23A liq	27±8.3 to 31±9.8	41±14 to 51±17	23±7.2 to 12±3.7	1.4±0.5 to 1.6±0.6	5.8±1.8 to 2.8±0.9	1.4±0.5 to 1.8±0.7	2.8±1.4 to 2.2±1.1	445, 175
SY-101-22A crust	33±3.9 to 38±4.0	27±4.5 to 32±5.0	20±2.4 to 22±2.3	0.6±0.1 to 0.7±0.1	19±4.8 to 6.6±1.6	0.4±0.1 to 0.5±0.1	54±27 to 46±23	942, 371
SY-101-22A liq	32±8.8 to 38±10	33±11 to 42±14	26±7.3 to 14±4.1	1.3±0.4 to 1.6±0.5	6.4±1.9 to 3.1±0.9	1.2±0.4 to 1.6±0.6	3.1±1.6 to 2.4±1.2	451, 177
High composition error bands result from a combination of relatively small amounts of sample gas and large amounts of air contamination.								
The ± values represent the measurement error band. The two central values are, first, the one based on the highest salt effect on gas solubility (lower-bound solubility); second, the one based on the lowest salt effect on gas solubility (upper-bound solubility). Only one central value is given in cases where gas solubility has too little effect to show up in the significant figures.								

Step 2 of 7 - Original Tables for breakdown of "Other" components

Source: "rgs FinalSumTable.doc" Personal Communication from Lenna Mahoney. Not previously published.

Tank and Sample (or Layer)	Mole Percent of Constituent in Bubbles					
	CH ₄	C ₂ H _x	C ₃ H _x	Other	Other HC	Other N ₂ O _x
AW-101 solids	1.7±0.2	1.1±0.2 to 1.2±0.2	0.26±0.1 to 0.27±0.1	1.3±0.3 to 1.4±0.3	0.12±0.06 to 0.12±0.07	2.8±0.5 to 2.9±0.6
A-101 upper	0.7±0.1	0.12±0.02	0.07±0.03	0.11±0.03	0.07±0.02	0.3±0.06
AN-105 solids	0.7±0.07	0.11±0.04 to 0.12±0.05	0.06±0.02	0.19±0.06 to 0.20±0.07	0.18±0.04 to 0.21±0.04	0.6±0.1
AN-104 solids	0.9±0.2	0.30±0.10 to 0.31±0.11	0.08±0.03	0.44±0.18 to 0.46±0.19	0.03±0.02	0.8±0.3 to 0.9±0.3
AN-103 crust	0.6±0.07	0.13±0.02	0.04±0.01	0.05±0.01	0.02±0.01	0.2±0.06
AN-103 solids	0.6±0.1	0.15±0.05 to 0.16±0.05	0.07±0.02 to 0.08±0.05	0.15±0.06	0.02±0.02 to 0.03±0.02	0.4±0.1
LI-103 slurry	0.4±0.03	0.41±0.04	0±0.02	0.04±0.01	0.01±0.01	0.5±0.06
LI-103 solids	0.4±0.06 to 0.5±0.09	0.59±0.10 to 0.64±0.10	0.02±0.02	0.09±0.02	0.14±0.04 to 0.16±0.05	0.8±0.2 to 0.9±0.2
S-106 solids	0.2±0.07	0.24±0.19 to 0.25±0.19	0.13±0.07	0.06±0.03	0.05±0.04 to 0.06±0.04	0.5±0.3
BY-109 below ILL	0.8±0.1	1.0±0.2 to 1.1±0.2	0.15±0.07	1.1±0.2	0.01±0.01 to 0.02±0.01	2.3±0.4
SX-106 solids	0.6±0.1	0.20±0.07 to 0.21±0.07	0.08±0.01	0.06±0.03 to	0.01±0.01 to 0.01±0.01	0.4±0.1
AX-101-9D-8	2.4±0.2 to 2.5±0.2	0.45±0.19 to 0.48±0.20		0.22±0.12 to 0.24±0.13		0.7±0.3
S-102 tank avg.	0.4±0.07	0.10±0.03		0.06±0.03 to 0.07±0.03		0.2±0.06
S-111 solids	0.4±0.07 to 0.5±0.07	0.08±0.03		0.07±0.04		0.2±0.07
LI-109 tank avg.	0.7±0.1	0.28±0.06 to 0.29±0.06		0.13±0.07 to		0.4±0.2
SY-101-022 crust	0.6±0.06 to 0.7±0.09	0.56±0.15 to 0.67±0.17		0.06±0.03 to 0.07±0.04		0.6±0.2 to 0.7±0.2
SY-101-021 crust	0.6±0.1 to 0.7±0.1	0.36±0.06 to 0.47±0.10		0.05±0.02 to 0.06±0.03		0.4±0.1 to 0.5±0.1
SY-101-022 liq.	1.3±0.5 to 1.6±0.6	0.70±0.32 to 0.87±0.40		0.67±0.41 to 0.83±0.51		1.4±0.7 to 1.7±0.9
SY-101-021 liq.	1.3±0.4 to 1.6±0.5	0.66±0.27 to 0.83±0.34		0.54±0.31 to 0.67±0.39		1.2±0.6 to 1.5±0.7

Step 3 of 7 - Combine Original and "Other" Component Tables

Tank and Sample (or Layer)		± to											range normalize				low salt range	
		AWV-101 solids	cb dists high salt	high salt mean	high salt range	high salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	high salt range			mean	std dev	forecasts	mean	
											forecasts	mean	std dev					
Mole Percent of Constituent in Bubbles	H2	32±3.2 to 33±3.2	31.908	32.000	3.200	1.067	33.000	33.000	3.200	1.067	31.908	32.08	1.08	30.40	1.08	33.000	32.08	
	N2	56±6.2 to 58±6.4	55.000	56.000	6.200	2.067	57.000	58.000	6.400	2.133	55.120	56.21	2.08	53.30	2.08	57.120	58.24	
	N2O	7.2±0.8 to 4.4±0.5	7.500	7.200	0.800	0.267	5.000	4.400	0.500	0.167	7.500	7.20	0.28	6.83	0.28	5.000	4.40	
	CH4	1.7±0.2	1.700	1.700	0.200	0.067	-	-	-	0.001	9.383	9.39	0.43	8.90	0.43	8.275	8.26	
	NH3	0.8±0.3	0.800	0.800	0.300	0.100	-	-	-	0.001	0.800	0.60	0.10	0.57	0.10	-	-	
	Other	2.8±0.5 to 2.9±0.6	-	2.800	0.500	0.167	-	2.800	0.600	0.200	-	-	-	-	-	-	-	
	CH4	1.7±0.2	-	1.700	0.200	0.067	-	-	-	0.001	-	-	-	-	-	-	-	
	C2Hx	1.1±0.2 to 1.2±0.2	1.100	1.100	0.200	0.067	1.200	1.200	0.200	0.067	-	-	-	-	-	-	-	
	C3Hx	0.26±0.1 to 0.27±0.1	0.260	0.260	0.100	0.033	0.270	0.270	0.100	0.033	-	-	-	-	-	-	-	
	Other HC	1.3±0.3 to 1.4±0.3	1.300	1.300	0.300	0.100	1.400	1.400	0.300	0.100	-	-	-	-	-	-	-	
	Other NOx	0.12±0.06 to 0.12±0.07	0.120	0.120	0.060	0.020	0.120	0.120	0.070	0.023	-	-	-	-	-	-	-	
	Total "Other"	2.8±0.5 to 2.9±0.6	-	2.800	0.500	0.167	-	2.800	0.600	0.200	-	-	-	-	-	-	-	
				100.28							104.709	105.45	100.00		103.395	103.85	0	

												range normalize							
Tank and Sample (or Layer)		A-101 upper	cb dists high salt	high salt range			cb dists low salt	low salt range		low salt std dev	high salt range			low salt range					
				high salt mean	high salt range	low salt std dev		low salt mean	low salt range		forecasts	mean	std dev	mean	std dev	forecasts	mean		
Mole Percent of Constituent in Bubbles	H2	72±7.1	69.000	72.000	7.100	2.367	-	-	-	0.001	69.000	72.01	2.30	71.37	2.30	-	-		
	N2	19±4.9	20.000	19.000	4.900	1.633	-	-	-	0.001	20.070	19.07	1.64	18.90	1.64	-	-		
	N2O	5.8±0.6 to 5.3±0.5	5.700	5.800	0.600	0.200	5.500	5.300	0.500	0.167	5.700	5.80	0.20	5.75	0.20	5.500	5.30		
	CH4	0.7±0.1	0.700	0.700	0.100	0.033	-	-	-	0.001	1.515	1.51	0.06	1.50	0.06	-	-		
	NH3	2.5±0.9	4.400	2.500	0.900	0.300	-	-	-	0.001	4.400	2.49	0.30	2.47	0.30	-	-		
	Other	0.3±0.06	-	0.300	0.060	0.020	-	-	-	0.001	-	-	-	-	-	-	-		
	CH4	0.7±0.1	-	0.700	0.100	0.033	-	-	-	0.001	-	-	-	-	-	-	-		
	C2Hx	0.12±0.02	0.120	0.120	0.020	0.007	-	-	-	0.001	-	-	-	-	-	-	-		
	C3Hx	0.07±0.03	0.070	0.070	0.030	0.010	-	-	-	0.001	-	-	-	-	-	-	-		
	Other HC	0.11±0.03	0.110	0.110	0.030	0.010	-	-	-	0.001	-	-	-	-	-	-	-		
	Other NOx	0.07±0.02	0.070	0.070	0.020	0.007	-	-	-	0.001	-	-	-	-	-	-	-		
	Total "Other"	0.3±0.06	0.300	0.060	0.020	-	-	-	-	0.001	-	-	-	-	-	-	-		
			100.37						100.685			100.90		100.00			5.5		5.30

Tank and Sample (or Layer)		AN-105 solids	high salt range										range normalize		low salt range		
			cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	forecasts	mean	std dev	mean	std dev	forecasts	mean
Mole Percent of Constituent in Bubbles	H2	60±5.4 to 62±5.5	61.000	60.000	5.400	1.800	63.000	62.000	5.500	1.833	61.000	59.96	1.79	59.67	1.79	63.000	61.85
	N2	24±4.0 to 25±3.9	22.000	24.000	4.000	1.333	23.000	25.000	3.900	1.300	22.180	24.24	1.36	24.13	1.36	23.210	25.24
	N2O	14±1.5 to 11±1.1	15.000	14.000	1.500	0.500	12.000	11.000	1.100	0.367	15.000	14.01	0.49	13.94	0.49	12.000	10.99
	CH4	0.7±0.09	0.700	0.700	0.090	0.030	-	-	-	0.001	1.768	1.77	0.09	1.76	0.09	1.000	1.00
	NH3	0.5±0.2	0.600	0.500	0.200	0.067	-	-	-	0.001	0.600	0.50	0.06	0.50	0.06	-	-
	Other	0.6±0.1	-	0.600	0.100	0.033	-	-	-	0.001	-	-	-	-	-	-	-

G-9

[illegible]RPP-10006 REV 7

high salt range range normalize low salt range

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "3-Revised comps"

Tank and Sample (or Layer)	U-103 solids	cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	forecasts		high salt		low salt range		forecasts	
										mean	std dev	mean	std dev	mean	std dev	mean	std dev
Mole Percent of Constituent in Bubbles	H2	23±1.4 to 24±1.5	21.000	23.000	1.400	0.467	22.000	24.000	1.500	0.500	21.000	23.01	0.46	22.87	0.46	22.000	24.01
	N2	36±2.3 to 38±2.4	35.000	36.000	2.300	0.767	38.000	38.000	2.400	0.800	35.140	36.19	0.77	35.97	0.77	38.160	38.12
	N2O	39±2.4 to 37±2.2	41.000	39.000	2.400	0.800	38.000	37.000	2.200	0.733	41.000	39.03	0.79	38.79	0.79	38.000	37.00
	CH4	0.4±0.05	0.400	0.400	0.050	0.017	-	-	-	0.001	1.793	1.79	0.07	1.78	0.07	1.067	1.06
	NH3	0.6±0.3 to 0.5±0.2	1.500	0.600	0.300	0.100	0.800	0.500	0.200	0.067	1.500	0.60	0.10	0.59	0.10	0.800	0.50
	Other	0.8±0.2 to 0.9±0.2	-	0.800	0.200	0.067	-	0.900	0.200	0.067	-	-	-	-	-	-	-
	CH4	0.4±0.08 to 0.5±0.09	-	0.400	0.080	0.027	-	0.500	0.090	0.030	-	-	-	-	-	-	-
	C2Hx	0.59±0.10 to 0.64±0.10	0.590	0.590	0.100	0.033	0.640	0.640	0.100	0.033	-	-	-	-	-	-	-
	C3Hx	0.02±0.02	0.020	0.020	0.020	0.007	-	-	-	0.001	-	-	-	-	-	-	-
	Other HC	0.08±0.02	0.090	0.090	0.020	0.007	-	-	-	0.001	-	-	-	-	-	-	-
	Other NOx	0.14±0.04 to 0.16±0.05	0.140	0.140	0.040	0.013	0.160	0.160	0.050	0.017	-	-	-	-	-	-	-
	Total "Other"	0.8±0.2 to 0.9±0.2	-	0.800	0.200	0.067	-	0.900	0.200	0.067	-	-	-	-	-	-	-
				99.84							100.4333	100.63		100.00		100.0267	100.70

Tank and Sample (or Layer)	S-108 solids	cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	forecasts		high salt		low salt range		forecasts	
										mean	std dev	mean	std dev	mean	std dev	mean	std dev
Mole Percent of Constituent in Bubbles	H2	63±5.7 to 65±5.9	63.000	63.000	5.700	1.900	65.000	65.000	5.900	1.967	63.000	62.94	1.90	62.57	1.90	65.000	64.96
	N2	25±3.7 to 26±3.8	25.000	25.000	3.700	1.233	-	26.000	3.800	1.267	25.050	25.06	1.24	24.91	1.24	0.060	0.06
	N2O	11±1.0 to 8.4±0.8	11.000	11.000	1.000	0.333	9.000	8.400	0.800	0.267	11.000	11.03	0.34	10.96	0.34	9.000	8.40
	CH4	0.3±0.08	0.200	0.300	0.080	0.027	-	-	-	0.001	1.165	1.27	0.14	1.26	0.14	0.417	0.41
	NH3	0.3±0.2	0.400	0.300	0.200	0.067	-	-	-	0.001	0.400	0.30	0.07	0.30	0.07	-	-
	Other	0.5±0.3	-	0.500	0.300	0.100	-	-	-	0.001	-	-	-	-	-	-	-
	CH4	0.2±0.07	-	0.200	0.070	0.023	-	-	-	0.001	-	-	-	-	-	-	-
	C2Hx	0.24±0.19 to 0.25±0.19	0.240	0.240	0.190	0.063	0.250	0.250	0.190	0.063	-	-	-	-	-	-	-
	C3Hx	0.13±0.07	0.130	0.130	0.070	0.023	-	-	-	0.001	-	-	-	-	-	-	-
	Other HC	0.06±0.03	0.060	0.060	0.030	0.010	-	-	-	0.001	-	-	-	-	-	-	-
	Other NOx	0.05±0.04 to 0.06±0.04	0.050	0.050	0.040	0.013	0.060	0.060	0.040	0.013	-	-	-	-	-	-	-
	Total "Other"	0.5±0.3	-	0.500	0.300	0.100	-	-	-	0.001	-	-	-	-	-	-	-
				100.08							100.615	100.59		100.00		74.47667	73.83

Tank and Sample (or Layer)	BY-109 below salt ILL	cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	forecasts		high salt		low salt range		forecasts	
										mean	std dev	mean	std dev	mean	std dev	mean	std dev
Mole Percent of Constituent in Bubbles	H2	50±5.5 to 51±5.6	50.000	50.000	5.500	1.833	51.000	51.000	5.600	1.867	50.000	50.03	1.87	47.86	1.87	51.000	51.03
	N2	29±5.1	28.000	29.000	5.100	1.700	-	-	-	0.001	28.010	29.02	1.78	27.77	1.78	0.020	0.02
	N2O	18±2.5 to 16±2.3	18.000	18.000	2.500	0.833	17.000	16.000	2.300	0.767	18.000	17.93	0.84	17.15	0.84	17.000	16.00
	CH4	0.9±0.1	0.800	0.900	0.100	0.033	-	-	-	0.001	7.242	7.35	0.29	7.03	0.29	1.833	1.83
	NH3	0.2±0.1	0.300	0.200	0.100	0.033	-	-	-	0.001	0.300	0.20	0.03	0.19	0.03	-	-
	Other	2.3±0.4	-	2.300	0.400	0.133	-	-	-	0.001	-	-	-	-	-	-	-
	CH4	0.8±0.1	-	0.800	0.100	0.033	-	-	-	0.001	-	-	-	-	-	-	-

G-11

RPP-10006 REV 7

Tank and Sample (or Layer)		AX-101-9D-8	cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	high salt range			high salt range		low salt range	
											forecasts	mean	std dev	mean	std dev	forecasts	mean
Mole Percent of Constituent in Bubbles	H2	61±5.5 to 64±5.5	80.000	61.000	5.500	1.833	84.000	64.000	5.500	1.833	80.000	80.99	1.81	80.10	1.81	64.000	63.98
	N2	17±2.6 to 18±2.7	18.000	17.000	2.800	0.867	18.000	18.000	2.700	0.900	18.000	17.02	0.89	18.77	0.89	18.000	17.99
	N2O	11±1.0	11.000	11.000	1.000	0.333	-	-	-	0.001	11.000	11.01	0.34	10.85	0.34	-	-
	CH4	2.4±0.2 to 2.5±0.2	2.400	2.400	0.200	0.067	2.500	2.500	0.200	0.067	4.030	4.03	0.21	3.97	0.21	3.300	3.29
	NH3	8.4±1.9 to 4.3±1.0	9.200	8.400	1.900	0.633	3.500	4.300	1.000	0.333	9.200	8.43	0.65	8.30	0.65	3.500	4.30
	Other	0.7±0.3	-	0.700	0.300	0.100	-	-	-	0.001	-	-	-	-	-	-	-
	CH4	2.4±0.2 to 2.5±0.2	-	2.400	0.200	0.067	-	2.500	0.200	0.067	-	-	-	-	-	-	-
	C2Hx	0.45±0.19 to 0.48±0.20	0.450	0.450	0.190	0.063	0.480	0.480	0.200	0.067	-	-	-	-	-	-	-
	C3Hx	-	-	-	-	0.001	-	-	-	0.001	-	-	-	-	-	-	-
	Other HC	0.22±0.12 to 0.24±0.13	0.220	0.220	0.120	0.040	-	-	-	0.001	-	-	-	-	-	-	-
	Other NOx	-	-	-	-	0.001	-	-	-	0.001	-	-	-	-	-	-	-
	Total "Other"	0.7±0.3	-	0.700	0.300	0.100	-	-	-	0.001	-	-	-	-	-	-	-
				100.47							100.23	101.48		100.00		88.8	89.50

high salt range range low salt range
normalize

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "3-Revised comps"

Step 3 of 7 - Combine Original and "Other" Component Tables

Tank and Sample (or Layer)		S-102 tank avg.	cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	high salt range		high salt range		low salt range		
											forecasts	mean	std dev	mean	std dev	forecasts	mean
Mole Percent of Constituent in Bubbles	H2	33±3.0 to 35±3.1	32.000	33.000	3.000	1.000	34.000	35.000	3.100	1.033	32.000	33.06	1.05	33.06	1.05	34.000	35.01
	N2	32±4.3 to 33±4.5	31.000	32.000	4.300	1.433	32.000	33.000	4.500	1.500	31.000	31.97	1.41	31.99	1.41	32.000	33.06
	N2O	33±3.1 to 31±2.9	33.000	33.000	3.100	1.033	32.000	31.000	2.900	0.967	33.000	33.00	1.04	33.03	1.04	32.000	31.02
	CH4	0.4±0.06 to 0.5±0.06	0.400	0.400	0.060	0.020	0.500	0.500	0.060	0.020	0.807	0.81	0.05	0.81	0.05	0.500	0.50
	NH3	1.1±0.4 to 0.6±0.2	3.200	1.100	0.400	0.133	1.300	0.800	0.200	0.067	3.200	1.10	0.14	1.10	0.14	1.300	0.60
	Other	0.2±0.06	-	0.200	0.060	0.020	-	-	-	0.001	-	-	-	-	-	-	-
	CH4	0.4±0.07	-	0.400	0.070	0.023	-	-	-	0.001	-	-	-	-	-	-	-
	C2Hx	0.10±0.03	0.100	0.100	0.030	0.010	-	-	-	0.001	-	-	-	-	-	-	-
	C3Hx	-	-	-	-	0.001	-	-	-	0.001	-	-	-	-	-	-	-
	Other HC	0.06±0.03 to 0.07±0.03	0.060	0.060	0.030	0.010	-	-	-	0.001	-	-	-	-	-	-	-
	Other NOx	-	-	-	-	0.001	-	-	-	0.001	-	-	-	-	-	-	-
	Total "Other"	0.2±0.06	-	0.200	0.060	0.020	-	-	-	0.001	-	-	-	-	-	-	-
											100.0067	99.93		100.00		99.8	100.19

Tank and Sample (or Layer)		S-111 solids	high salt range										high salt range		low salt range		
			cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	forecasts	mean	std dev	mean	std dev	forecasts	mean
Mole Percent of Constituent in Bubbles	H2	66±10 to 67±11	66.000	66.000	10.000	3.333	69.000	67.000	11.000	3.667	68.000	65.84	3.21	65.90	3.21	66.000	66.95
	N2	21±5.6 to 22±5.8	20.000	21.000	5.600	1.867	22.000	22.000	5.800	1.933	20.000	21.02	1.91	21.04	1.91	22.000	21.94
	N2O	11±1.7 to 9.6±1.5	11.000	11.000	1.700	0.567	10.000	9.800	1.500	0.500	11.000	11.04	0.59	11.05	0.59	10.000	9.63
	CH4	0.5±0.08	0.400	0.500	0.080	0.027	-	-	-	0.001	0.813	0.91	0.07	0.91	0.07	-	-
	NH3	1.1±0.4 to 0.6±0.2	1.000	1.100	0.400	0.133	0.600	0.800	0.200	0.067	1.000	1.10	0.13	1.10	0.13	0.600	0.80
	Other	0.2±0.07	-	0.200	0.070	0.023	-	-	-	0.001	-	-	-	-	-	-	-
	CH4	0.4±0.07 to 0.5±0.07	-	0.400	0.070	0.023	-	0.500	0.070	0.023	-	-	-	-	-	-	-
	C2Hx	0.08±0.03	0.080	0.080	0.030	0.010	-	-	-	0.001	-	-	-	-	-	-	-
	C3Hx	-	-	-	-	0.001	-	-	-	0.001	-	-	-	-	-	-	-
	Other HC	0.07±0.04	0.070	0.070	0.040	0.013	-	-	-	0.001	-	-	-	-	-	-	-
	Other NOx	-	-	-	-	0.001	-	-	-	0.001	-	-	-	-	-	-	-
	Total "Other"	0.2±0.07	-	0.200	0.070	0.023	-	-	-	0.001	-	-	-	-	-	-	-
			99.75								100.8133	99.91		100.00		101.6	99.12

Tank and Sample (or Layer)		U-109 solids	cb dists high salt	high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	high salt range			high salt range		low salt range	
											forecasts	mean	std dev	mean	std dev	forecasts	mean
Mole Percent of Constituent in Bubbles	H2	25±3.1 to 26±3.2	25.000	25.000	3.100	1.033	26.000	26.000	3.200	1.067	25.000	24.95	1.04	24.75	1.04	26.000	26.03
	N2	46±7.8 to 48±8.1	45.000	46.000	7.800	2.600	47.000	48.000	8.100	2.700	45.000	46.02	2.66	45.65	2.66	47.000	48.19
	N2O	27±3.5 to 24±3.2	28.000	27.000	3.500	1.167	26.000	24.000	3.200	1.067	28.000	26.95	1.17	26.73	1.17	26.000	23.97
	CH4	0.7±0.1 to 0.8±0.1	0.700	0.700	0.100	0.033	0.800	0.800	0.100	0.033	1.687	1.69	0.11	1.68	0.11	0.800	0.80
	NH3	1.2±0.5 to 0.6±0.2	0.800	1.200	0.500	0.167	0.400	0.800	0.200	0.067	0.800	1.19	0.17	1.18	0.17	0.400	0.60
	Other	0.4±0.2		0.400	0.200	0.067	-	-	-	0.001							

G-13

RPP-10006 REV 7

Tank and Sample (or Layer)		SY-101 ave (see below)	cb dists high salt	high salt range								high salt range		low salt range			
				high salt mean	high salt range	low salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev	forecasts	mean	std dev	mean	std dev	forecasts	mean
Mole Percent of Constituent in Bubbles	H2	31.75±6.35 to 36.57±0.0	31.750	31.750	6.350	2.117	26.000	36.500	7.075	2.358	31.750	31.69	2.17	31.29	2.17	28.000	36.41
	N2	32.25±4.525 to 39.25±1.0	45.000	32.250	8.525	2.842	47.000	39.250	10.225	3.408	45.000	32.28	2.62	31.88	2.62	47.000	39.35
	N2O	22.25±4.85 to 17.25±3.0	28.000	22.250	4.850	1.617	26.000	17.250	3.125	1.042	28.000	22.20	1.60	21.92	1.60	26.000	17.27
	CH4	0.975±0.2725 to 0.975±0.0	0.700	0.975	0.273	0.091	1.150	0.975	0.300	0.100	1.687	3.25	0.30	3.21	0.30	1.150	0.97
	NH3	11.8±3.1 to 4.8±1.25	0.800	11.800	3.100	1.033	0.400	4.800	1.250	0.417	0.800	11.85	1.06	11.70	1.06	0.400	4.80
	Other	0.9±0.4 to 1.1±0.475		0.900	0.400	0.133		1.100	0.475	0.158							
	CH4	0.95±0.27 to 1.15±0.3225		0.950	0.270	0.090		1.150	0.323	0.108							
	C2Hx	0.575±0.205 to 0.71±0.0	0.260	0.575	0.205	0.068	-	0.710	0.253	0.084							
	C3Hx		-	-	-	0.001	-	-	-	0.001							
	Other HC	0.33±0.1925 to 0±0	0.130	0.330	0.193	0.064	-	-	-	0.001							
	Other NOx		-	-	-	0.001	-	-	-	0.001							
Total "Other"		0.9±0.4 to 1.1±0.475		0.900	0.400	0.133		1.100	0.475	0.158							
				99.93							107.2367	101.25		100.00		100.55	98.80

Tank and Sample (or Layer)		SY-101-022A crust	cb dists high salt	high salt range							high salt			low salt range			
				high salt mean	high salt range	high salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev				mean	std dev		
				forecasts	mean	std dev	mean	std dev	forecasts	mean							
Mole Percent of Constituent in Bubbles	H2	33±3.9 to 38±4.0	33.000	33.000	3.900	1.300	38.000	38.000	4.000	1.333	33.000	-	-	#DIV/0!	0.00	38.000	-
	N2	27±4.5 to 32±5.0	27.000	27.000	4.500	1.500	32.000	32.000	5.000	1.667	27.000	-	-	#DIV/0!	0.00	32.000	-
	N2O	20±2.4 to 22±2.3	20.000	20.000	2.400	0.800	22.000	22.000	2.300	0.767	20.000	-	-	#DIV/0!	0.00	22.000	-
	CH4	0.6±0.1 to 0.7±0.1	0.600	0.600	0.100	0.033	0.700	0.700	0.100	0.033	1.773	-	-	#DIV/0!	0.00	0.700	-
	NH3	19±4.8 to 6.8±1.6	19.000	19.000	4.800	1.600	6.600	6.600	1.600	0.533	19.000	-	-	#DIV/0!	0.00	6.600	-
	Other	0.6±0.2 to 0.7±0.2		0.600	0.200	0.067		0.700	0.200	0.067							
	CH4	0.6±0.08 to 0.7±0.09		0.600	0.080	0.027		0.700	0.090	0.030							
	C2Hx	0.56±0.15 to 0.67±0.17	0.560	0.560	0.150	0.050	-	0.670	0.170	0.057							
	C3Hx		-	-	-	-	-	-	-	-							
	Other HC	0.06±0.03 to 0.07±0.04	0.060	0.060	0.030	0.010	-	-	-	-							
	Other NOx		-	-	-	-	-	-	-	-							
Total "Other"	0.6±0.2 to 0.7±0.2		0.800	0.200	0.067		0.700	0.200	0.067								
				100.22							100.7733	-		#DIV/0!	99.3	-	

Step 3 of 7 - Combine Original and "Other" Component Tables

Tank and Sample (or Layer)		SY-101-023A crust	cb dists high salt	high salt mean	high salt range	high salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev
Mole Percent of Constituent in Bubbles	H2	35±4.4 to 39±4.5	25.000	35.000	4.400	1.467	26.000	39.000	4.500	1.500
	N2	28±4.6 to 32±4.9	45.000	28.000	4.600	1.533	47.000	32.000	4.900	1.633
	N2O	20±2.5 to 21±2.4	28.000	20.000	2.500	0.833	26.000	21.000	2.400	0.800
	CH4	0.6±0.09	0.700	0.600	0.090	0.030	-	-	-	-
	NH3	16±3.9 to 6.7±1.6	0.800	16.000	3.900	1.300	0.400	6.700	1.600	0.533
	Other	0.4±0.1 to 0.5±0.1	-	0.400	0.100	0.033	-	0.500	0.100	0.033
	CH4	0.6±0.1 to 0.7±0.1	-	0.600	0.100	0.033	-	0.700	0.100	0.033
	C2Hx	0.38±0.08 to 0.47±0.10	0.280	0.380	0.080	0.027	-	0.470	0.100	0.033
	C3Hx	-	-	-	-	-	-	-	-	-
	Other HC	0.05±0.02 to 0.06±0.03	0.130	0.050	0.020	0.007	-	-	-	-
	Other NOx	-	-	-	-	-	-	-	-	-
	Total "Other"	0.4±0.1 to 0.5±0.1	-	0.400	0.100	0.033	-	0.500	0.100	0.033
				100.03						

Tank and Sample (or Layer)		SY-101-022A liq.	cb dists high salt	high salt mean	high salt range	high salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev
Mole Percent of Constituent in Bubbles	H2	32±8.8 to 38±10	25.000	32.000	8.800	2.933	26.000	38.000	10.000	3.333
	N2	33±11 to 42±14	45.000	33.000	11.000	3.667	47.000	42.000	14.000	4.667
	N2O	26±7.3 to 14±4.1	28.000	26.000	7.300	2.433	26.000	14.000	4.100	1.367
	CH4	1.3±0.4 to 1.6±0.5	0.700	1.300	0.400	0.133	-	1.600	0.500	0.167
	NH3	6.4±1.9 to 3.1±0.9	0.800	6.400	1.900	0.633	0.400	3.100	0.900	0.300
	Other	1.4±0.7 to 1.7±0.9	-	1.400	0.700	0.233	-	1.700	0.900	0.300
	CH4	1.3±0.5 to 1.6±0.6	-	1.300	0.500	0.167	-	1.600	0.600	0.200
	C2Hx	0.70±0.32 to 0.87±0.40	0.280	0.700	0.320	0.107	-	0.870	0.400	0.133
	C3Hx	-	-	-	-	-	-	-	-	-
	Other HC	0.67±0.41 to 0.83±0.51	0.130	0.670	0.410	0.137	-	-	-	-
	Other NOx	-	-	-	-	-	-	-	-	-
	Total "Other"	1.4±0.7 to 1.7±0.9	-	1.400	0.700	0.233	-	1.700	0.900	0.300
				100.07						

Tank and Sample (or Layer)		SY-101-021 liq.	cb dists high salt	high salt mean	high salt range	high salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev
Mole Percent of Constituent in Bubbles	H2	27±8.3 to 31±9.8	25.000	27.000	8.300	2.767	26.000	31.000	9.800	3.267
	N2	41±14 to 51±17	45.000	41.000	14.000	4.667	47.000	51.000	17.000	5.667
	N2O	23±7.2 to 12±3.7	28.000	23.000	7.200	2.400	26.000	12.000	3.700	1.233
	CH4	1.4±0.5 to 1.6±0.6	0.700	1.400	0.500	0.167	-	1.600	0.600	0.200
	NH3	5.8±1.8 to 2.8±0.9	0.800	5.800	1.800	0.600	0.400	2.800	0.900	0.300
	Other	1.2±0.6 to 1.5±0.7	-	1.200	0.600	0.200	-	1.500	0.700	0.233
	CH4	1.3±0.4 to 1.6±0.6	-	1.300	0.400	0.133	-	1.600	0.600	0.167
	C2Hx	0.66±0.27 to 0.83±0.34	0.280	0.660	0.270	0.090	-	0.830	0.340	0.113

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "3-Revised comps"

Step 3 of 7 - Combine Original and "Other" Component Tables

	C3Hx										
	Other HC	0.54±0.31 to 0.67±0.39	0.130	0.540	0.310	0.103	-	-	-	-	-
	Other NOx		-	-	-	-	-	-	-	-	-
	Total "Other"	1.2±0.6 to 1.5±0.7		1.200	0.600	0.200		1.500	0.700	0.233	
				99.4							

Tank and Sample (or Layer)		SY-101 ave.	cb dists high salt	high salt mean	high salt range	high salt std dev	cb dists low salt	low salt mean	low salt range	low salt std dev
Mole Percent of Constituent in Bubbles	H2	31.75±6.35 to 36.5±7.075		31.8	6.4			36.5	7.1	
	N2	32.25±8.525 to 39.25±10.225		32.3	8.5			39.3	10.2	
	N2O	22.25±4.85 to 17.25±3.125		22.3	4.9			17.3	3.1	
	CH4	0.975±0.2725 to 0.975±0.3		1.0	0.3			1.0	0.3	
	NH3	11.8±3.1 to 4.8±1.25		11.8	3.1			4.8	1.3	
	Other	0.9±0.4 to 1.1±0.475		0.9	0.4			1.1	0.5	
	CH4	0.95±0.27 to 1.15±0.3225		1.0	0.3			1.2	0.3	
	C2Hx	0.575±0.205 to 0.71±0.2525		0.6	0.2			0.7	0.3	
	C3Hx			-	-			-	-	
	Other HC	0.33±0.1925 to 0±0		0.3	0.2			-	-	
	Other NOx			-	-			-	-	
	Total "Other"	0.9±0.4 to 1.1±0.475		0.9	0.4			1.1	0.5	
				99.93						

Step 3 of 7 - Comt

Tank and Sample (or Layer)		range normalize													
		std dev	mean	std dev	Forecast: i5	i4	i5	i6	i7	i8	q4	q5	q6	q7	q8
Mole Percent of Constituent in Bubbles	H2	1.07	32.96	1.07	Statistic	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
	N2	2.12	58.24	2.12	Trials	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000
	N2O	0.16	4.40	0.16	Mean	32.08	56.21	7.20	9.39	0.60	32.96	58.24	4.40	8.26	0
	CH4	0.44	8.26	0.44	Median	32.05	56.20	7.19	9.39	0.60	32.97	58.30	4.40	8.26	0
	NH3	-	-	0.00	Mode	--	--	--	--	--	--	--	--	--	--
	Other				Standard Deviation	1.08	2.08	0.28	0.43	0.10	1.07	2.12	0.16	0.44	0
	CH4				Variance	1.17	4.34	0.08	0.19	0.01	1.13	4.50	0.03	0.20	0
	C2Hx				Skewness	0.01	0.07	0.15	0.04	(0.04)	(0.01)	(0.09)	0.12	(0.01)	0
	C3Hx				Kurtosis	3.08	2.90	2.97	2.96	3.10	3.07	2.83	3.01	2.82	0
	Other HC				Coeff. of Variability	0.03	0.04	0.04	0.05	0.17	0.03	0.04	0.04	0.05	0
	Other NOx				Range Minimum	28.59	49.17	6.34	8.07	0.24	29.48	52.31	3.96	6.91	0
	Total "Other"				Range Maximum	35.50	63.64	8.14	10.66	0.93	36.26	64.08	4.90	9.59	0
					Range Width	6.91	14.47	1.80	2.58	0.69	6.78	11.77	0.95	2.67	0
			103.85												
		range normalize			Mean Std. Error	0.03	0.07	0.01	0.01	0.00	0.03	0.07	0.01	0.01	0
Tank and Sample (or Layer)		range normalize													
		std dev	mean	std dev	Forecast: i18	i19	i20	i21	i22	i23	q19	q20	q21	q22	q23
Mole Percent of Constituent in Bubbles	H2	-	-	0.00	Statistic	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
	N2	-	-	0.00	Trials	1,000.00	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	N2O	0.16	5.30	0.16	Mean	72.01	19.07231	5.804437	1.514441	2.491777	0	0	5.30306	0	0
	CH4	-	-	0.00	Median	71.99	19.10886	5.805911	1.513705	2.490027	0	0	5.297358	0	0
	NH3	-	-	0.00	Mode	--	--	--	--	--	--	--	--	--	--
	Other				Standard Deviation	2.30	1.637624	0.197938	0.056187	0.30377	0	0	0.16398	0	0
	CH4				Variance	5.29	2.681812	0.039179	0.003157	0.092276	0	0	0.02689	0	0
	C2Hx				Skewness	(0.01)	0.002951	0.083533	-0.015194	-0.03119	0	0	0.014966	0	0
	C3Hx				Kurtosis	3.00	2.908455	2.75474	3.342326	2.927584	0	0	2.853926	0	0
	Other HC				Coeff. of Variability	0.03	0.085864	0.034101	0.037101	0.121909	0	0	0.030922	0	0
	Other NOx				Range Minimum	63.84	14.12633	5.175467	1.264558	1.439239	0	0	4.78108	0	0
	Total "Other"				Range Maximum	79.51	23.93819	6.379857	1.708608	3.427062	0	0	5.796693	0	0
			5.30		Range Width	15.66	9.811861	1.20439	0.44205	1.987823	0	0	1.015613	0	0
			range normalize			Mean Std. Error	0.07	0.051786	0.006259	0.001777	0.009606	0	0	0.005186	0
Tank and Sample (or Layer)		range normalize													
		std dev	mean	std dev	Forecast: i33	i34	i35	i36	i37	i38	q34	q35	q36	q37	q38
Mole Percent of Constituent in Bubbles	H2	1.87	61.85	1.87	Statistic	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
	N2	1.34	25.24	1.34	Trials	1,000	1,000	1,000	1,000	1,000	1000	1000	1,000	1,000	1,000
	N2O	0.36	10.99	0.36	Mean	59.95776	24.24491	14.00738	1.770787	0.501593	61.854	25.238	10.98679	0.997884	0
	CH4	0.10	1.00	0.10	Median	59.95472	24.25552	13.99885	1.767847	0.49809	61.851	25.228	10.98165	1.000053	0
	NH3	-	-	0.00	Mode	--	--	--	--	--	--	--	--	--	--
	Other				Standard Deviation	1.785854	1.364731	0.493763	0.089343	0.064696	1.870	1.343	0.360386	0.098247	0

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”

Step 3 of 7 - Comt

CH4	Variance	3.189274	1.86249	0.243802	0.007982	0.004186	3.496	1.804	0.129878	0.009052	0
C2Hx	Skewness	-0.005243	-0.174528	-0.017678	0.134001	0.142467	-0.01	0.02	0.049127	-0.091965	0
C3Hx	Kurtosis	3.040792	3.195469	2.923574	2.7839	2.962868	2.70	2.70	3.126106	3.213292	0
Other HC	Coeff. of Variability	0.029785	0.056289	0.03525	0.050454	0.12898	0.03	0.05	0.032802	0.098455	0
Other NOx	Range Minimum	54.04147	19.02917	12.41771	1.516806	0.305079	56.699	21.203	9.886958	0.673734	0
Total "Other"	Range Maximum	65.61884	28.23635	15.42897	2.071723	0.702529	66.932	29.468	12.31259	1.305372	0
	Range Width	11.57736	9.207179	3.011265	0.555117	0.39745	10.233	8.265	2.425627	0.631638	0
	Mean Std. Error	0.056474	0.043157	0.015614	0.002825	0.002046	0.059	0.042	0.011396	0.003107	0

range
normalize

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I50	I51	I52	I53	I54	q50	q51	q52	q53	q54
					Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Mole Percent of Constituent in Bubbles				Statistic	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
H2	2.34	46.88	2.34	Trials	45.01309	29.06324	23.0237	3.358001	0.896019	46.88424	30.91883	20.05061	2.337768	0
N2	1.72	30.92	1.72	Mean	44.99728	29.04332	23.05964	3.357393	0.891358	46.97163	30.8813	20.05277	2.338867	0
N2O	1.07	20.05	1.07	Median										
CH4	0.25	2.34	0.25	Mode										
NH3	-	-	0.00	Standard Deviation	2.324619	1.560725	1.199418	0.238141	0.131958	2.342188	1.72249	1.089311	0.254815	0
Other				Variance	5.403855	2.435863	1.438603	0.056711	0.017413	5.465845	2.968971	1.143425	0.064931	0
CH4				Skewness	0.064836	0.03668	0.072719	0.026806	0.075635	-0.08027	-0.044557	0.035086	0.011753	0
C2Hx				Kurtosis	2.949772	2.884611	2.685125	2.888823	2.734561	3.213638	3.078716	2.842746	3.001134	0
C3Hx				Coeff. of Variability	0.051643	0.053701	0.052095	0.070917	0.147271	0.049957	0.05571	0.053331	0.108999	0
Other HC				Range Minimum	38.10845	24.77493	19.28304	2.677887	0.535348	38.86256	24.67646	16.60584	1.536088	0
Other NOx				Range Maximum	52.91165	33.76235	26.65321	4.080312	1.295246	53.92881	36.58766	23.88315	3.208745	0
Total "Other"				Range Width	14.8032	9.007419	7.370176	1.402425	0.759898	15.06624	11.9112	7.277312	1.672657	0
				Mean Std. Error	0.073511	0.049354	0.037929	0.007531	0.004173	0.074066	0.05447	0.033815	0.008058	0

low salt
range

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I66	I67	I68	I69	I70	q66	q67	q68	q69	q70
					Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Mole Percent of Constituent in Bubbles				Statistic	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
H2	2.45	61.88	2.45	Trials	61.09724	33.15394	4.107946	1.825054	0.600153	61.87688	0	3.393619	9.256306	0
N2	-	-	0.00	Mean	61.08775	33.19719	4.106573	1.823509	0.602614	61.91958	0	3.390024	9.253442	0
N2O	0.17	3.39	0.17	Median										
CH4	0.43	9.26	0.43	Mode										
NH3	-	-	0.00	Standard Deviation	2.589754	1.443614	0.192837	0.090859	0.064592	2.449459	0	0.169177	0.426529	0
Other				Variance	6.706828	2.084022	0.037186	0.008255	0.004172	5.999847	0	0.028621	0.181927	0
CH4				Skewness	-0.030381	-0.14043	0.027975	-0.005071	-0.092141	0.008726	0	-0.075192	-0.119742	0
C2Hx				Kurtosis	3.098639	2.995667	3.209291	2.95928	2.87668	2.738604	0	2.895973	2.91889	0
C3Hx				Coeff. of Variability	0.042387	0.043543	0.046943	0.055912	0.107625	0.039586	0	0.049851	0.04608	0
Other HC				Range Minimum	51.37039	28.11163	3.337206	1.335281	0.406588	55.24226	0	2.89077	7.875715	0
Other NOx				Range Maximum	69.89569	38.28999	4.795109	1.935551	0.774052	68.8558	0	3.928313	10.69459	0
Total "Other"				Range Width	18.5253	10.17837	1.457902	0.60027	0.367484	13.81353	0	1.037543	2.818879	0
				Mean Std. Error	0.081895	0.045651	0.006098	0.002873	0.002043	0.077459	0	0.00535	0.013488	0

range
normalize

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "3-Revised comps"

Step 3 of 7 - Comt

Tank and Sample (or Layer)		std dev	mean	std dev	Forecast: forecasts	I82	I83	I84	I85	I86	q82	q83	q84	q85	q86
						Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Mole Percent of Constituent in Bubbles	H2	0.51	23.84	0.51	Statistic	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	N2	0.85	37.86	0.85	Trials	23.01222	36.191	39.032	1.793	0.598	24.01025	38.123	37.002	1.065	0.498
	N2O	0.73	36.75	0.73	Mean	22.99235	36.218	39.028	1.793	0.599	24.00625	38.129	37.009	1.067	0.497
	CH4	0.06	1.06	0.06	Median	—	—	—	—	—	—	—	—	—	—
	NH3	0.07	0.49	0.07	Mode	—	—	—	—	—	—	—	—	—	—
	Other	—	—	—	Standard Deviation	0.483645	0.768	0.793	0.068	0.101	0.513694	0.848	0.726	0.057	0.066
	CH4	—	—	—	Variance	0.214968	0.590	0.628	0.005	0.010	0.263881	0.719	0.527	0.003	0.004
	C2Hx	—	—	—	Skewness	0.037809	-0.04	0.00	0.02	-0.01	0.09577	0.06	-0.06	0.03	0.00
	C3Hx	—	—	—	Kurtosis	2.863681	2.86	3.00	3.11	3.07	3.0713	2.90	3.18	2.76	2.90
	Other HC	—	—	—	Coeff. of Variability	0.020148	0.02	0.02	0.04	0.17	0.021395	0.02	0.02	0.05	0.13
	Other NOx	—	—	—	Range Minimum	21.47335	33.822	36.456	1.551	0.205	22.56075	35.285	34.324	0.906	0.295
	Total "Other"	—	—	—	Range Maximum	24.6611	38.750	41.607	2.035	0.965	25.93175	40.818	39.371	1.233	0.684
		—	—	—	Range Width	3.187744	4.928	5.151	0.483	0.760	3.370996	5.534	5.047	0.327	0.389
		—	—	—	Mean Std. Error	0.014662	0.024	0.025	0.002	0.003	0.016244	0.027	0.023	0.002	0.002
		low salt													
Tank and Sample (or Layer)		std dev	mean	std dev	Forecast: forecasts	I98	I99	I100	I101	I102	q98	q99	q100	q101	q102
						Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Mole Percent of Constituent in Bubbles	H2	1.97	64.96	1.97	Statistic	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	N2	0.01	0.06	0.01	Trials	62.93817	25.06257	11.02574	1.267329	0.300	64.956	0.059	8.401	0.411	0.000
	N2O	0.26	8.40	0.26	Mean	62.94575	25.03802	11.01643	1.270495	0.302	65.037	0.059	8.402	0.408	0.000
	CH4	0.10	0.41	0.10	Median	—	—	—	—	—	—	—	—	—	0.000
	NH3	—	—	—	Mode	—	—	—	—	—	—	—	—	—	0.000
	Other	—	—	—	Standard Deviation	1.90308	1.238056	0.340172	0.135504	0.066	1.966	0.013	0.260	0.104	0.000
	CH4	—	—	—	Variance	3.621638	1.532782	0.115717	0.018361	0.004	3.863	0.000	0.067	0.011	0.000
	C2Hx	—	—	—	Skewness	-0.031757	0.069583	0.070258	0.024109	-0.10	-0.04	0.01	-0.02	-0.04	0.00
	C3Hx	—	—	—	Kurtosis	3.187417	2.981485	2.824637	3.361847	2.87	2.91	2.84	2.96	2.90	+Infinity
	Other HC	—	—	—	Coeff. of Variability	0.030237	0.049399	0.030853	0.106921	0.22	0.03	0.22	0.03	0.25	+Infinity
	Other NOx	—	—	—	Range Minimum	56.74488	21.36598	9.958403	0.806792	0.082	59.155	0.021	7.591	0.036	0.000
	Total "Other"	—	—	—	Range Maximum	69.74762	29.04999	12.01873	1.711023	0.478	70.761	0.096	9.246	0.710	0.000
		—	—	—	Range Width	13.00294	7.684008	2.059326	0.904231	0.396	11.606	0.076	1.655	0.674	0.000
		—	—	—	Mean Std. Error	0.06018	0.039151	0.010757	0.004285	0.002	0.062	0.000	0.008	0.003	0.000
		low salt range													
Tank and Sample (or Layer)		std dev	mean	std dev	Forecast: forecasts	I114	I115	I116	I117	I118	q114	q115	q116	q117	q118
						Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Mole Percent of Constituent in Bubbles	H2	1.87	51.03	1.87	Statistic	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	N2	0.00	0.02	0.00	Trials	50.0274	29.025	17.931	7.349	0.199	51.029	0.020	15.995	1.834	0
	N2O	0.75	16.00	0.75	Mean	50.01945	29.012	17.896	7.351	0.199	50.979	0.020	15.980	1.833	0
	CH4	0.11	1.83	0.11	Median	—	—	—	—	—	—	—	—	—	0
	NH3	—	—	—	Mode	—	—	—	—	—	—	—	—	—	0
	Other	—	—	—	Standard Deviation	1.865785	1.785	0.838	0.289	0.033	1.873	0.003	0.752	0.109	0
	CH4	—	—	—	Variance	3.481152	3.185	0.701	0.083	0.001	3.510	0.000	0.565	0.012	0

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”

Step 3 of 7 - Comt

C2Hx	Skewness	0.055144	-0.08	0.03	0.06	0.04	0.09	-0.08	0.03	0.04	0
C3Hx	Kurtosis	2.883377	2.87	2.97	2.94	2.98	3.10	2.95	2.95	2.83 +Infinity	0
Other HC	Coeff. of Variability	0.037295	0.06	0.05	0.04	0.17	0.04	0.17	0.05	0.06 +Infinity	0
Other NOx	Range Minimum	44.24394	23.386	15.329	6.324	0.091	45.483	0.008	13.721	1.514	0
Total "Other"	Range Maximum	55.80083	34.544	20.507	8.207	0.298	56.993	0.029	18.360	2.147	0
	Range Width	11.35688	11.158	5.177	1.883	0.207	11.510	0.021	4.639	0.632	0
	Mean Std. Error	0.059001	0.056	0.026	0.009	0.001	0.059	0.000	0.024	0.003	0

low salt
range

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I130 Value	I131 Value	I132 Value	I133 Value	I134 Value	q130 Value	q131 Value	q132 Value	q133 Value	q134 Value
Mole Percent of Constituent in Bubbles				Statistic	1000	1000	1000	1,000	1000	1,000	1000	1,000	1,000	1,000
H2	1.59	51.87	1.59	Trials	50.035	19.987	23.993	1.373	5.493	51.86914	20.987	0	0.352	2.408496
N2	1.36	20.99	1.36	Mean	50.017	19.931	23.969	1.371	5.496	51.84798	21.010	0	0.351	2.405735
N2O	-	-	0.00	Median	-	-	-	-	-	-	-	0	-	-
CH4	0.04	0.35	0.04	Mode	1.482	1.240	0.924	0.066	0.391	1.569249	1.369	0	0.037	0.167437
NH3	0.17	2.41	0.17	Standard Deviation	2.195	1.538	0.854	0.004	0.153	2.525711	1.848	0	0.001	0.028035
Other				Variance	0.07	0.00	0.01	0.08	-0.02	0.123631	-0.11	0	0.12	0.08208
CH4				Skewness	2.87	2.95	2.88	2.82	2.67	3.160258	3.14 +Infinity	0	2.88	2.753777
C2Hx				Kurtosis	0.03	0.06	0.04	0.05	0.07	0.03064	0.06 +Infinity	0	0.11	0.068577
C3Hx				Coeff. of Variability	45.881	15.596	21.324	1.183	4.367	46.48411	16.662	0	0.242	1.916467
Other HC				Range Minimum	55.077	24.147	26.801	1.575	6.570	57.43874	25.374	0	0.476	2.932501
Other NOx				Range Maximum	9.196	8.551	5.477	0.393	2.204	10.95462	8.712	0	0.234	1.016035
Total "Other"				Range Width	0.047	0.039	0.029	0.002	0.012	0.050256	0.043	0	0.001	0.005295
				Mean Std. Error										

low salt
range

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I146 Value	I147 Value	I148 Value	I149 Value	I150 Value	q146 Value	q147 Value	q148 Value	q149 Value	q150 Value
Mole Percent of Constituent in Bubbles				Statistic	1,000	1000	1000	1000	1000	1000	1000	1000	1000	1000
H2	1.90	63.98	1.90	Trials	60.99244	17.020	11.012	4.029	8.427	63.982	17.993	0.000	3.292	4.301
N2	0.91	17.99	0.91	Mean	60.95552	17.048	11.008	4.024	8.428	63.976	17.972	0.000	3.297	4.302
N2O	-	-	0.00	Median	-	-	-	-	-	-	-	0.000	-	-
CH4	0.13	3.29	0.13	Mode	1.806333	0.866	0.338	0.206	0.647	1.903	0.911	0.000	0.128	0.320
NH3	0.32	4.30	0.32	Standard Deviation	3.282841	0.764	0.114	0.042	0.419	3.622	0.831	0.000	0.016	0.103
Other				Variance	0.037275	-0.12	0.03	-0.04	0.07	0.08	0.12	0.00	0.01	0.14
CH4				Skewness	3.02641	2.75	3.02	3.17	3.45	2.83	3.07	+Infinity	3.03	3.00
C2Hx				Kurtosis	0.029618	0.05	0.03	0.05	0.08	0.03	0.05	+Infinity	0.04	0.07
C3Hx				Coeff. of Variability	54.38282	14.379	9.956	3.293	6.358	58.018	15.082	0.000	2.883	3.496
Other HC				Range Minimum	67.08688	19.280	12.082	4.615	10.966	70.198	21.555	0.000	3.714	5.681
Other NOx				Range Maximum	12.70426	4.901	2.126	1.321	4.607	12.181	6.473	0.000	0.831	2.186
Total "Other"				Range Width	0.057121	0.028	0.011	0.007	0.020	0.060	0.029	0.000	0.004	0.010
				Mean Std. Error										

range
normalize

Step 3 of 7 - Comt

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I162 Value	I163 Value	I164 Value	I165 Value	I166 Value	q162 Value	q163 Value	q164 Value	q165 Value	q166 Value
Mole Percent of Constituent in Bubbles				Statistic	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
H2	1.04	34.94	1.04	Trials	33.053	31.969	33.003	0.809	1.100	35.011	33.065	31.015	0.500	0.599
N2	1.51	33.00	1.51	Mean	33.047	31.949	32.992	0.808	1.098	34.999	33.108	30.978	0.499	0.600
N2O	0.96	30.96	0.96	Median	—	—	—	—	—	—	—	—	—	—
CH4	0.02	0.50	0.02	Mode	1.049	1.409	1.039	0.048	0.135	1.040	1.514	0.955	0.020	0.066
NH3	0.07	0.60	0.07	Standard Deviation	1.099	1.998	1.080	0.002	0.018	1.081	2.292	0.913	0.000	0.004
Other				Variance	-0.10	-0.02	0.09	0.09	-0.04	0.00	0.01	0.15	0.08	-0.17
CH4				Skewness	3.02	2.80	2.95	2.74	2.94	3.15	2.71	3.21	2.90	3.28
C2Hx				Kurtosis	0.03	0.04	0.03	0.06	0.12	0.03	0.05	0.03	0.04	0.11
C3Hx				Coeff. of Variability	29.403	27.588	29.675	0.654	0.579	31.489	29.137	27.623	0.446	0.349
Other HC				Range Minimum	36.214	36.207	36.434	0.955	1.499	38.221	37.258	35.156	0.566	0.807
Other NOx				Range Maximum	6.811	8.819	6.760	0.301	0.921	6.733	8.122	7.532	0.120	0.458
Total "Other"				Range Width	0.033	0.045	0.033	0.002	0.004	0.033	0.048	0.030	0.001	0.002
		100.00		Mean Std. Error										

low salt range

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: Q180	I178 Value	I179 Value	I180 Value	I181 Value	I182 Value	q178 Value	q179 Value	q180 Value	q181 Value	q182 Value
Mole Percent of Constituent in Bubbles				Statistic	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
H2	3.65	66.95	3.65	Trials	65.836	21.022	11.037	0.912	1.098	66.945	21.939	9.634	0.000	0.601
N2	1.92	21.94	1.92	Mean	65.883	21.082	11.056	0.914	1.092	66.963	22.009	9.618	0.000	0.600
N2O	0.49	9.63	0.49	Median	—	—	—	—	—	—	—	—	0.000	—
CH4	-	-	0.00	Mode	3.205	1.911	0.586	0.065	0.134	3.651	1.917	0.490	0.000	0.065
NH3	0.07	0.60	0.07	Standard Deviation	10.274	3.652	0.343	0.004	0.018	13.332	3.674	0.240	0.000	0.004
Other				Variance	0.02	-0.13	-0.12	-0.02	0.07	-0.08	-0.12	0.16	0.00	-0.01
CH4				Skewness	3.10	3.20	2.92	2.97	3.06	2.85	2.92	3.20	+Infinity	3.01
C2Hx				Kurtosis	0.05	0.09	0.05	0.07	0.12	0.05	0.09	0.05	+Infinity	0.11
C3Hx				Coeff. of Variability	55.091	13.643	9.250	0.706	0.653	55.800	16.077	7.823	0.000	0.386
Other HC				Range Minimum	76.886	26.540	12.951	1.121	1.587	77.675	27.331	11.443	0.000	0.791
Other NOx				Range Maximum	21.795	12.897	3.701	0.415	0.934	22.075	11.254	3.620	0.000	0.406
Total "Other"				Range Width	0.101	0.060	0.019	0.002	0.004	0.115	0.061	0.015	0.000	0.002
		99.12		Mean Std. Error										

low salt range

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I194 Value	I195 Value	I196 Value	I197 Value	I198 Value	q194 Value	q195 Value	q196 Value	q197 Value	q198 Value
Mole Percent of Constituent in Bubbles				Statistic	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
H2	1.08	26.14	1.08	Trials	24.950	46.021	26.949	1.689	1.193	26.028	48.185	23.967	0.802	0.598
N2	2.76	48.39	2.76	Mean	24.962	46.080	26.978	1.686	1.194	25.986	48.098	23.964	0.800	0.597
N2O	1.05	24.07	1.05	Median	—	—	—	—	—	—	—	—	—	—
CH4	0.03	0.80	0.03	Mode	1.040	2.663	1.167	0.114	0.166	1.083	2.755	1.052	0.035	0.067
NH3	0.07	0.60	0.07	Standard Deviation										
Other														

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “3-Revised comps”

Step 3 of 7 - Comt

CH4	Variance	1.082	7.091	1.363	0.013	0.028	1.172	7.591	1.107	0.001	0.004
C2Hx	Skewness	-0.02	-0.06	-0.03	-0.04	0.01	-0.03	0.04	0.10	0.05	-0.06
C3Hx	Kurtosis	2.76	2.97	3.01	2.98	3.07	3.11	3.06	3.32	2.93	2.94
Other HC	Coeff. of Variability	0.04	0.06	0.04	0.07	0.14	0.04	0.06	0.04	0.04	0.11
Other NOx	Range Minimum	21.951	38.041	23.451	1.314	0.648	22.102	39.269	20.321	0.694	0.346
Total "Other"	Range Maximum	28.293	55.583	31.345	1.997	1.728	29.107	58.391	28.111	0.906	0.787
	Range Width	6.342	17.542	7.894	0.683	1.080	7.005	19.122	7.790	0.212	0.442
	Mean Std. Error	0.033	0.084	0.037	0.004	0.005	0.034	0.087	0.033	0.001	0.002

low salt
range

Tank and Sample (or Layer)	std dev	mean	std dev	Forecast: forecasts	I210	I211	I212	I213	I214	q210	q211	q212	q213	q214
Mole Percent of				Statistic	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
N2	2.32	36.85	2.32	Trials	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
N2O	3.36	39.83	3.36	Mean	31.687	32.275	22.197	3.249	11.846	36.410	39.352	17.270	0.973	4.789
CH4	1.06	17.48	1.06	Median	31.720	32.286	22.249	3.266	11.817	36.448	39.233	17.240	0.973	4.790
NH3	0.10	0.98	0.10	Mode	—	—	—	—	—	—	—	—	—	—
Other	0.41	4.86	0.41	Standard Deviation	2.171	2.625	1.596	0.301	1.063	2.321	3.358	1.059	0.099	0.413
CH4				Variance	4.715	6.890	2.548	0.090	1.129	5.385	11.276	1.121	0.010	0.170
C2Hx				Skewness	-0.01	-0.03	0.00	0.06	0.00	0.05	0.09	0.00	0.01	-0.05
C3Hx				Kurtosis	2.79	2.91	2.91	2.93	3.04	2.95	3.01	3.05	2.92	3.06
Other HC				Coeff. of Variability	0.07	0.08	0.07	0.09	0.09	0.06	0.09	0.06	0.10	0.09
Other NOx				Range Minimum	24.928	25.188	17.544	2.399	8.357	28.634	28.320	13.529	0.655	3.352
Total "Other"				Range Maximum	38.640	40.524	27.870	4.280	15.661	44.079	51.256	20.510	1.263	6.247
				Range Width	13.711	15.336	10.326	1.881	7.204	15.444	22.938	8.981	0.609	2.895
				Mean Std. Error	0.069	0.083	0.050	0.010	0.034	0.073	0.106	0.033	0.003	0.013

low salt

Tank and Sample (or Layer)	std dev	mean	std dev
Mole Percent of			
N2	-	-	0.00
N2O	-	-	0.00
CH4	-	-	0.00
NH3	-	-	0.00
Other	-	-	0.00
CH4			
C2Hx			
C3Hx			
Other HC			
Other NOx			
Total "Other"			

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”

Cell Equations

Cell	Value	Formula
c4	32±3.2 to 33±3.2	32±3.2 to 33±3.2
c5	56±6.2 to 58±6.4	56±6.2 to 58±6.4
c6	7.2±0.8 to 4.4±0.5	7.2±0.8 to 4.4±0.5
c7	1.7±0.2	1.7±0.2
c8	0.6±0.3	0.6±0.3
c9	2.8±0.5 to 2.9±0.6	2.8±0.5 to 2.9±0.6
c10	1.7±0.2	1.7±0.2
c11	1.1±0.2 to 1.2±0.2	1.1±0.2 to 1.2±0.2
c12	0.26±0.1 to 0.27±0.1	0.26±0.1 to 0.27±0.1
c13	1.3±0.3 to 1.4±0.3	1.3±0.3 to 1.4±0.3
c14	0.12±0.06 to 0.12±0.07	0.12±0.06 to 0.12±0.07
c15	2.8±0.5 to 2.9±0.6	2.8±0.5 to 2.9±0.6
c16		
d4	31.90562462	31.90562462
d5	55	55
d6	7.5	7.5
d7	1.7	1.7
d8	0.8	0.8
d9		
d10		
d11	1.1	1.1
d12	0.26	0.26
d13	1.3	1.3
d14	0.12	0.12
d15		
d16		
e4	32	=IF (ISERR (FIND (\$E\$2, C307, 1)), 0, VALUE (LEFT (C307, FIND (\$E\$2, C307, 1) - 1)))
e5	56	=IF (ISERR (FIND (\$E\$2, C308, 1)), 0, VALUE (LEFT (C308, FIND (\$E\$2, C308, 1) - 1)))
e6	7.2	=IF (ISERR (FIND (\$E\$2, C309, 1)), 0, VALUE (LEFT (C309, FIND (\$E\$2, C309, 1) - 1)))
e7	1.7	=IF (ISERR (FIND (\$E\$2, C310, 1)), 0, VALUE (LEFT (C310, FIND (\$E\$2, C310, 1) - 1)))
e8	0.6	=IF (ISERR (FIND (\$E\$2, C311, 1)), 0, VALUE (LEFT (C311, FIND (\$E\$2, C311, 1) - 1)))
e9	2.8	=IF (ISERR (FIND (\$E\$2, C312, 1)), 0, VALUE (LEFT (C312, FIND (\$E\$2, C312, 1) - 1)))
e10	1.7	=IF (ISERR (FIND (\$E\$2, C313, 1)), 0, VALUE (LEFT (C313, FIND (\$E\$2, C313, 1) - 1)))
e11	1.1	=IF (ISERR (FIND (\$E\$2, C314, 1)), 0, VALUE (LEFT (C314, FIND (\$E\$2, C314, 1) - 1)))
e12	0.26	=IF (ISERR (FIND (\$E\$2, C315, 1)), 0, VALUE (LEFT (C315, FIND (\$E\$2, C315, 1) - 1)))
e13	1.3	=IF (ISERR (FIND (\$E\$2, C316, 1)), 0, VALUE (LEFT (C316, FIND (\$E\$2, C316, 1) - 1)))
e14	0.12	=IF (ISERR (FIND (\$E\$2, C317, 1)), 0, VALUE (LEFT (C317, FIND (\$E\$2, C317, 1) - 1)))
e15	2.8	=IF (ISERR (FIND (\$E\$2, C318, 1)), 0, VALUE (LEFT (C318, FIND (\$E\$2, C318, 1) - 1)))
e16	100.28	=SUM (E307:E318) - E312 - E313 - E318
f4	3.2	=IF (ISERR (FIND (\$F\$2, C307)), 0, IF (ISERR (FIND (\$F\$2, C307)), VALUE (RIGHT (C307, LEN (C307) - FIND (\$E\$2, C307))) , VALUE (MID (C307, FIND (\$E\$2, C307) + 1, FIND (\$F\$2, C307) - FIND (\$E\$2, C307) - 1))))
f5	6.2	=IF (ISERR (FIND (\$F\$2, C308)), 0, IF (ISERR (FIND (\$F\$2, C308)), VALUE (RIGHT (C308, LEN (C308) - FIND (\$E\$2, C308))) , VALUE (MID (C308, FIND (\$E\$2, C308) + 1, FIND (\$F\$2, C308) - FIND (\$E\$2, C308) - 1))))
f6	0.8	=IF (ISERR (FIND (\$F\$2, C309)), 0, IF (ISERR (FIND (\$F\$2, C309)), VALUE (RIGHT (C309, LEN (C309) - FIND (\$E\$2, C309))) , VALUE (MID (C309, FIND (\$E\$2, C309) + 1, FIND (\$F\$2, C309) - FIND (\$E\$2, C309) - 1))))
f7	0.2	=IF (ISERR (FIND (\$F\$2, C310)), 0, IF (ISERR (FIND (\$F\$2, C310)), VALUE (RIGHT (C310, LEN (C310) - FIND (\$E\$2, C310))) , VALUE (MID (C310, FIND (\$E\$2, C310) + 1, FIND (\$F\$2, C310) - FIND (\$E\$2, C310) - 1))))

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”

Cell Equations

Cell	Value	Formula
f8	0.3	=IF (ISERR (FIND (\$F\$2, C311)), 0, IF (ISERR (FIND (\$F\$2, C311)), VALUE (RIGHT (C311, LEN (C311) - FIND (\$E\$2, C311))), VALUE (MID (C311, FIND (\$E\$2, C311) + 1, FIND (\$F\$2, C311) - FIND (\$E\$2, C311) - 1))))
f9	0.5	=IF (ISERR (FIND (\$F\$2, C312)), 0, IF (ISERR (FIND (\$F\$2, C312)), VALUE (RIGHT (C312, LEN (C312) - FIND (\$E\$2, C312))), VALUE (MID (C312, FIND (\$E\$2, C312) + 1, FIND (\$F\$2, C312) - FIND (\$E\$2, C312) - 1))))
f10	0.2	=IF (ISERR (FIND (\$F\$2, C313)), 0, IF (ISERR (FIND (\$F\$2, C313)), VALUE (RIGHT (C313, LEN (C313) - FIND (\$E\$2, C313))), VALUE (MID (C313, FIND (\$E\$2, C313) + 1, FIND (\$F\$2, C313) - FIND (\$E\$2, C313) - 1))))
f11	0.2	=IF (ISERR (FIND (\$F\$2, C314)), 0, IF (ISERR (FIND (\$F\$2, C314)), VALUE (RIGHT (C314, LEN (C314) - FIND (\$E\$2, C314))), VALUE (MID (C314, FIND (\$E\$2, C314) + 1, FIND (\$F\$2, C314) - FIND (\$E\$2, C314) - 1))))
f12	0.1	=IF (ISERR (FIND (\$F\$2, C315)), 0, IF (ISERR (FIND (\$F\$2, C315)), VALUE (RIGHT (C315, LEN (C315) - FIND (\$E\$2, C315))), VALUE (MID (C315, FIND (\$E\$2, C315) + 1, FIND (\$F\$2, C315) - FIND (\$E\$2, C315) - 1))))
f13	0.3	=IF (ISERR (FIND (\$F\$2, C316)), 0, IF (ISERR (FIND (\$F\$2, C316)), VALUE (RIGHT (C316, LEN (C316) - FIND (\$E\$2, C316))), VALUE (MID (C316, FIND (\$E\$2, C316) + 1, FIND (\$F\$2, C316) - FIND (\$E\$2, C316) - 1))))
f14	0.06	=IF (ISERR (FIND (\$F\$2, C317)), 0, IF (ISERR (FIND (\$F\$2, C317)), VALUE (RIGHT (C317, LEN (C317) - FIND (\$E\$2, C317))), VALUE (MID (C317, FIND (\$E\$2, C317) + 1, FIND (\$F\$2, C317) - FIND (\$E\$2, C317) - 1))))
f15	0.5	=IF (ISERR (FIND (\$F\$2, C318)), 0, IF (ISERR (FIND (\$F\$2, C318)), VALUE (RIGHT (C318, LEN (C318) - FIND (\$E\$2, C318))), VALUE (MID (C318, FIND (\$E\$2, C318) + 1, FIND (\$F\$2, C318) - FIND (\$E\$2, C318) - 1))))
f16		
g4	2.366666667	=IF (ISERR (F307 / 3), 0.001, MAX (+ F307 / 3, 0.001))
g5	1.633333333	=IF (ISERR (F308 / 3), 0.001, MAX (+ F308 / 3, 0.001))
g6	0.2	=IF (ISERR (F309 / 3), 0.001, MAX (+ F309 / 3, 0.001))
g7	0.033333333	=IF (ISERR (F310 / 3), 0.001, MAX (+ F310 / 3, 0.001))
g8	0.3	=IF (ISERR (F311 / 3), 0.001, MAX (+ F311 / 3, 0.001))
g9	0.02	=IF (ISERR (F312 / 3), 0.001, MAX (+ F312 / 3, 0.001))
g10	0.033333333	=IF (ISERR (F313 / 3), 0.001, MAX (+ F313 / 3, 0.001))
g11	0.006666667	=IF (ISERR (F314 / 3), 0.001, MAX (+ F314 / 3, 0.001))
g12	0.01	=IF (ISERR (F315 / 3), 0.001, MAX (+ F315 / 3, 0.001))
g13	0.01	=IF (ISERR (F316 / 3), 0.001, MAX (+ F316 / 3, 0.001))
g14	0.006666667	=IF (ISERR (F317 / 3), 0.001, MAX (+ F317 / 3, 0.001))
g15	0.02	=IF (ISERR (F318 / 3), 0.001, MAX (+ F318 / 3, 0.001))
g16		
h4	33	
h5	57	
h6	5	
h7		
h8		
h9		
h10		
h11	1.2	
h12	0.27	
h13	1.4	
h14	0.12	
h15		
h16		
i4	33	=IF (ISERR (FIND (\$F\$2, C307)), 0, VALUE (MID (C307, FIND (\$F\$2, C307) + LEN (\$F\$2), FIND (\$E\$2, C307, FIND (\$F\$2, C307) + 1) - (FIND (\$F\$2, C307) + LEN (\$F\$2))))
i5	58	=IF (ISERR (FIND (\$F\$2, C308)), 0, VALUE (MID (C308, FIND (\$F\$2, C308) + LEN (\$F\$2), FIND (\$E\$2, C308, FIND (\$F\$2, C308) + 1) - (FIND (\$F\$2, C308) + LEN (\$F\$2))))
i6	4.4	=IF (ISERR (FIND (\$F\$2, C309)), 0, VALUE (MID (C309, FIND (\$F\$2, C309) + LEN (\$F\$2), FIND (\$E\$2, C309, FIND (\$F\$2, C309) + 1) - (FIND (\$F\$2, C309) + LEN (\$F\$2))))
i7	0	=IF (ISERR (FIND (\$F\$2, C310)), 0, VALUE (MID (C310, FIND (\$F\$2, C310) + LEN (\$F\$2), FIND (\$E\$2, C310, FIND (\$F\$2, C310) + 1) - (FIND (\$F\$2, C310) + LEN (\$F\$2))))

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”
Cell Equations

Cell	Value	Formule
I8		"=IF (ISERR (FIND (\$F\$2, C311)) , 0, VALUE (MID (C311, FIND (\$F\$2, C311) + LEN (\$F\$2) , FIND (\$E\$2, C311, FIND (\$F\$2, C311) + 1) - (FIND (\$F\$2, C311) + LEN (\$F\$2)))))
I9	2.9	"=IF (ISERR (FIND (\$F\$2, C312)) , 0, VALUE (MID (C312, FIND (\$F\$2, C312) + LEN (\$F\$2) , FIND (\$E\$2, C312, FIND (\$F\$2, C312) + 1) - (FIND (\$F\$2, C312) + LEN (\$F\$2)))))
I10	0	"=IF (ISERR (FIND (\$F\$2, C313)) , 0, VALUE (MID (C313, FIND (\$F\$2, C313) + LEN (\$F\$2) , FIND (\$E\$2, C313, FIND (\$F\$2, C313) + 1) - (FIND (\$F\$2, C313) + LEN (\$F\$2)))))
I11	1.2	"=IF (ISERR (FIND (\$F\$2, C314)) , 0, VALUE (MID (C314, FIND (\$F\$2, C314) + LEN (\$F\$2) , FIND (\$E\$2, C314, FIND (\$F\$2, C314) + 1) - (FIND (\$F\$2, C314) + LEN (\$F\$2)))))
I12	0.27	"=IF (ISERR (FIND (\$F\$2, C315)) , 0, VALUE (MID (C315, FIND (\$F\$2, C315) + LEN (\$F\$2) , FIND (\$E\$2, C315, FIND (\$F\$2, C315) + 1) - (FIND (\$F\$2, C315) + LEN (\$F\$2)))))
I13	1.4	"=IF (ISERR (FIND (\$F\$2, C316)) , 0, VALUE (MID (C316, FIND (\$F\$2, C316) + LEN (\$F\$2) , FIND (\$E\$2, C316, FIND (\$F\$2, C316) + 1) - (FIND (\$F\$2, C316) + LEN (\$F\$2)))))
I14	0.12	"=IF (ISERR (FIND (\$F\$2, C317)) , 0, VALUE (MID (C317, FIND (\$F\$2, C317) + LEN (\$F\$2) , FIND (\$E\$2, C317, FIND (\$F\$2, C317) + 1) - (FIND (\$F\$2, C317) + LEN (\$F\$2)))))
I15	2.9	"=IF (ISERR (FIND (\$F\$2, C318)) , 0, VALUE (MID (C318, FIND (\$F\$2, C318) + LEN (\$F\$2) , FIND (\$E\$2, C318, FIND (\$F\$2, C318) + 1) - (FIND (\$F\$2, C318) + LEN (\$F\$2)))))
I16		
J4	3.2	"=IF (ISERR (FIND (\$F\$2, C307)) , 0, VALUE (RIGHT (C307, LEN (C307) - FIND (\$E\$2, C307, FIND (\$F\$2, C307) + 1) - (LEN (\$E\$2) - 1))))
J5	6.4	"=IF (ISERR (FIND (\$F\$2, C308)) , 0, VALUE (RIGHT (C308, LEN (C308) - FIND (\$E\$2, C308, FIND (\$F\$2, C308) + 1) - (LEN (\$E\$2) - 1))))
J6	0.5	"=IF (ISERR (FIND (\$F\$2, C309)) , 0, VALUE (RIGHT (C309, LEN (C309) - FIND (\$E\$2, C309, FIND (\$F\$2, C309) + 1) - (LEN (\$E\$2) - 1))))
J7	0	"=IF (ISERR (FIND (\$F\$2, C310)) , 0, VALUE (RIGHT (C310, LEN (C310) - FIND (\$E\$2, C310, FIND (\$F\$2, C310) + 1) - (LEN (\$E\$2) - 1))))
J8	0	"=IF (ISERR (FIND (\$F\$2, C311)) , 0, VALUE (RIGHT (C311, LEN (C311) - FIND (\$E\$2, C311, FIND (\$F\$2, C311) + 1) - (LEN (\$E\$2) - 1))))
J9	0.6	"=IF (ISERR (FIND (\$F\$2, C312)) , 0, VALUE (RIGHT (C312, LEN (C312) - FIND (\$E\$2, C312, FIND (\$F\$2, C312) + 1) - (LEN (\$E\$2) - 1))))
J10	0	"=IF (ISERR (FIND (\$F\$2, C313)) , 0, VALUE (RIGHT (C313, LEN (C313) - FIND (\$E\$2, C313, FIND (\$F\$2, C313) + 1) - (LEN (\$E\$2) - 1))))
J11	0.2	"=IF (ISERR (FIND (\$F\$2, C314)) , 0, VALUE (RIGHT (C314, LEN (C314) - FIND (\$E\$2, C314, FIND (\$F\$2, C314) + 1) - (LEN (\$E\$2) - 1))))
J12	0.1	"=IF (ISERR (FIND (\$F\$2, C315)) , 0, VALUE (RIGHT (C315, LEN (C315) - FIND (\$E\$2, C315, FIND (\$F\$2, C315) + 1) - (LEN (\$E\$2) - 1))))
J13	0.3	"=IF (ISERR (FIND (\$F\$2, C316)) , 0, VALUE (RIGHT (C316, LEN (C316) - FIND (\$E\$2, C316, FIND (\$F\$2, C316) + 1) - (LEN (\$E\$2) - 1))))
J14	0.07	"=IF (ISERR (FIND (\$F\$2, C317)) , 0, VALUE (RIGHT (C317, LEN (C317) - FIND (\$E\$2, C317, FIND (\$F\$2, C317) + 1) - (LEN (\$E\$2) - 1))))
J15	0.6	"=IF (ISERR (FIND (\$F\$2, C318)) , 0, VALUE (RIGHT (C318, LEN (C318) - FIND (\$E\$2, C318, FIND (\$F\$2, C318) + 1) - (LEN (\$E\$2) - 1))))
J16		
K4	1.066666667	"=IF (ISERR (J4 / 3) , 0.001, MAX (+ J4 / 3, 0.001))
K5	2.133333333	"=IF (ISERR (J5 / 3) , 0.001, MAX (+ J5 / 3, 0.001))
K6	0.166666667	"=IF (ISERR (J6 / 3) , 0.001, MAX (+ J6 / 3, 0.001))
K7	0.001	"=IF (ISERR (J7 / 3) , 0.001, MAX (+ J7 / 3, 0.001))
K8	0.001	"=IF (ISERR (J8 / 3) , 0.001, MAX (+ J8 / 3, 0.001))
K9	0.2	"=IF (ISERR (J9 / 3) , 0.001, MAX (+ J9 / 3, 0.001))
K10	0.001	"=IF (ISERR (J10 / 3) , 0.001, MAX (+ J10 / 3, 0.001))
K11	0.066666667	"=IF (ISERR (J11 / 3) , 0.001, MAX (+ J11 / 3, 0.001))
K12	0.033333333	"=IF (ISERR (J12 / 3) , 0.001, MAX (+ J12 / 3, 0.001))
K13	0.1	"=IF (ISERR (J13 / 3) , 0.001, MAX (+ J13 / 3, 0.001))
K14	0.023333333	"=IF (ISERR (J14 / 3) , 0.001, MAX (+ J14 / 3, 0.001))
K15	0.2	"=IF (ISERR (J15 / 3) , 0.001, MAX (+ J15 / 3, 0.001))
K16		

RPP-10006 REV 7

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”

Cell Equations

Cell	Value	Formule
I4	31.90562462	"= + D307
I5	55.12	"= + D308 + D317
I6	7.5	"= + D309
I7	9.383333333	"= + D310 + D314*5 / 3 + D315*5 / 2 + D316*4
I8	0.8	"= + D311
I9		
I10		
I11		
I12		
I13		
I14		
I15		
I16	104.708958	"=SUM (L307:L318)
m4	32.05737627	"= + X309
m5	56.20912925	"= + Y309
m6	7.199081032	"= + Z309
m7	9.38931521	"= + AA309
m8	0.599613297	"=AB309
m9		
m10		
m11		
m12		
m13		
m14		
m15		
m16	105.4545151	"=SUM (M307:M318)
n4	1.081848013	"= + X312
n5	2.08239897	"= + Y312
n6	0.278946023	"= + Z312
n7	0.431529823	"= + AA312
n8	0.101245517	"= + AB312
n9		
n10		
n11		
n12		
n13		
n14		
n15		
n16		
o4	30.39924488	"= + M307 / M319*100
o5	53.30177586	"= + M308 / M319*100
o6	6.826716739	"= + M309 / M319*100
o7	8.903663541	"= + M310 / M319*100
o8	0.56859898	"= + M311 / M319*100
o9		
o10		
o11		
o12		
o13		
o14		
o15		
o16	100	"=SUM (O307:O318)
p4	1.081848013	"= + N307
p5	2.08239897	"= + N308
p6	0.278946023	"= + N309
p7	0.431529823	"= + N310
p8	0.101245517	"= + N311
p9		
p10		
p11		
p12		
p13		
p14		

RPP-10006 REV 7

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”
Cell Equations

Cell	Value	Formula
p15		
p16		
q4	33	"= + H307
q5	57.12	"= + H308 + H317
q6	5	"= + H309
q7	8.275	"= + H310 + H314*5 / 3 + H315*5 / 2 + H316*4
q8	0	"= + H311
q9		
q10		
q11		
q12		
q13		
q14		
q15		
q16	103.395	"=SUM (Q307:Q318)
r4	32.95593137	"= + AC309
r5	58.23768653	"= + AD309
r6	4.40194146	"= + AE309
r7	8.256572689	"= + AF309
r8	0	"=AG309
r9		
r10		
r11		
r12		
r13		
r14		
r15	0	"=IF (OR (R307*=0, R308*=0, R309*=0, R310*=0, R311*=0), 0, 1)
r16	103.852132	"=SUM (R307:R312)
s4	1.065328453	"= + AC312
s5	2.122268326	"= + AD312
s6	0.164811503	"= + AE312
s7	0.442054928	"= + AF312
s8	0	"= + AG312
s9		
s10		
s11		
s12		
s13		
s14		
s15		
s16		
t4	32.95593137	"=IF (R318*=0, + R307, + R307 / R319*100)
t5	58.23768653	"=IF (R318*=0, + R308, + R308 / R319*100)
t6	4.40194146	"=IF (R318*=0, + R309, + R309 / R319*100)
t7	8.256572689	"=IF (R318*=0, + R310, + R310 / R319*100)
t8	0	"=IF (R318*=0, + R311, + R311 / R319*100)
t9		
t10		
t11		
t12		
t13		
t14		
t15		
t16	103.852132	"=SUM (T307:T318)
u4	1.065328453	"= + S307
u5	2.122268326	"= + S308
u6	0.164811503	"= + S309
u7	0.442054928	"= + S310
u8	0	"= + S311
u9		
u10		
u11		
u12		

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “3-Revised comps”
Cell Equations

Cell	Value	Formula
u13		
u14		
u15		
u16		

3. Create forecasts in columns "L" and "Q" for the major components. Minor components are added to major components (NO_x add to N₂ and fuels are added to CH₄).
4. Run Crystal Ball for 1,000 trials.
5. Prepare Crystal Ball report.
6. Copy summary statistics to Columns "X" through "AG."

Combine Distributions for SY-101

7. Copy combined SY-101 values from range "C290 to C301" to "C210 to C221."
8. Repeat Step 2 for SY-101.
9. Repeat Step 3 for SY-101.
10. Repeat Step 4 for SY-101.
11. Repeat Step 5 for SY-101.
12. Repeat Step 6 for SY-101.
13. Clear all forecasts and assumptions from spreadsheet.

G2.3 CREATE DISTRIBUTIONS FOR RGS TANKS

Create the Four Distributions Required to Specify the Retained Gas Distributions for Each of the RGS Tanks

Tab "4-Gas comp by tanks"

1. Recalculate spreadsheet.
2. Set up "Step-wise Continuous" assumptions in cells in rows 8, 20, 32, 45, 58, 71, 84, 97, 110, 123, 136, 149, 162, 175 and columns "O", "S", "W", "AA."
 - a. Clear any existing assumptions.
 - b. Select custom distribution.
 - c. Select data, then enter the range of cells listed below the cell where the assumption cells.
 - d. Rescale to 1.00.
 - e. Save assumption.
 - f. If there are not four values to choose from use the original normal distribution.

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “4-Gas comp by tanks”

Tank and Sample (or Layer)		high salt range normalized		low salt range normalized		assumptions				AW-101					
AW-101 solids		mean	std dev	mean	std dev	low	mean1	mean2	high	H2			N2O		
Mole Percent of Constituent in Bubbles	H2	30.40	1.08	32.98	1.07	26.07	30.40	32.98	37.22	26.0719			-	31.6576	3.7427
	N2	53.30	2.08	58.24	2.12	44.97	53.30	58.24	66.73	30.3992			1.0000	18:N11	4.4019
	N2O	6.83	0.28	4.40	0.16	3.74	4.40	6.83	7.94	32.9559			1.0000		6.8267
	CH4	8.90	0.43	8.26	0.44	6.49	8.26	8.90	10.63	37.2172			-		7.9425
	NH3	0.57	0.10	-	-	-	-	0.57	0.97				12 AW-101 H2	31.6576	1
1		100.00		100.00						retainedGasCompositionNH3	0.6000				12 A
										retainedGasCompositionN2	53.7300	MEAN	AW-101 H2	31.1400	MEAN
										headspaceGasRatioCH4	0.2136	STDDEV	AW-101 H2	2.3991	STDDEV
										headspaceGasRatioN2O	0.1256				MEAN
															STDDEV
Tank and Sample (or Layer)		high salt range normalized		low salt range normalized		assumptions				A-101					
A-101 upper		mean	std dev	mean	std dev	low	mean1	mean2	high	H2			N2O		
Mole Percent of Constituent in Bubbles	H2	71.37	2.30	-	-	-	-	71.37	80.58	-			-	50.6499	4.6471
	N2	18.90	1.64	-	-	-	-	18.90	25.45	-			1.0000	120:N23	5.3031
	N2O	5.75	0.20	5.30	0.16	4.65	5.30	5.75	6.54	71.3740			1.0000	117:N20	5.7528
	CH4	1.50	0.06	-	-	-	-	1.50	1.73	80.5757			-		6.5445
	NH3	2.47	0.30	-	-	-	-	2.47	3.68				24 A-101 H2	50.6499	
2		100.00		79.23						retainedGasCompositionNH3	0.6000				24
										retainedGasCompositionN2	53.7300	MEAN	4 A-101 H2	31.1400	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV	4 A-101 H2	2.2719	STDDEV
										headspaceGasRatioN2O	0.1300				MEAN
															STDDEV
Tank and Sample (or Layer)		high salt range normalized		low salt range normalized		assumptions				AN-105					
AN-105 solids		mean	std dev	mean	std dev	low	mean1	mean2	high	H2			N2O		
Mole Percent of Constituent in Bubbles	H2	59.67	1.79	61.85	1.87	52.53	59.67	61.85	69.33	52.5265			-	60.8674	9.5452
	N2	24.13	1.36	25.24	1.34	18.67	24.13	25.24	30.61	59.6699			1.0000	132:N35	10.9868
	N2O	13.94	0.49	10.99	0.36	9.55	10.99	13.94	15.92	61.8540			1.0000	125:N28	13.9401
	CH4	1.76	0.09	1.00	0.10	0.60	1.00	1.76	2.12	69.3331			-		15.9152
	NH3														

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “4-Gas comp by tanks”

NH3		0.50	0.06	-	-	-	-	0.50	0.76	36 AN-105 H2 60.8674				
3		100.00		100.00						retainedGasCompositionNH3	0.6000		36 /	
										retainedGasCompositionN2	53.7300	MEAN	AN-105 H2 31.1400	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV	AN-105 H2 3.3698	STDDEV
										headspaceGasRatioN2O	0.1300			MEAN STDDEV
Tank and Sample (or Layer)		high salt range normalized		low salt range normalized		assumptions				AN-104				
AN-104 solids		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O		
Mole Percent of		H2	44.41	2.32	48.88	2.34	35.11	44.41	48.88	56.25	35.1133	-	45.6702	15.7734
Constituent in		N2	28.67	1.56	30.92	1.72	22.43	28.67	30.92	37.81	44.4117	1.0000	I45:N48	20.0506
Bubbles		N2O	22.72	1.20	20.05	1.07	15.77	20.05	22.72	27.51	46.8842	1.0000	I34:N37	22.7161
		CH4	3.31	0.24	2.34	0.25	1.32	2.34	3.31	4.27	56.2530	-		27.5138
		NH3	0.88	0.13	-	-	-	-	0.88	1.41	49 AN-104 H2 45.6702			
4		100.00		100.00						retainedGasCompositionNH3	0.6000		49 /	
										retainedGasCompositionN2	53.7300	MEAN	AN-104 H2 31.1400	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV	AN-104 H2 4.3661	STDDEV
										headspaceGasRatioN2O	0.1300			MEAN STDDEV
Tank and Sample (or Layer)		high salt range normalized		low salt range normalized		assumptions				AN-103				
AN-103 solids		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O		
Mole Percent of		H2	60.74	2.59	61.88	2.45	50.38	60.74	61.88	71.67	50.3833	-	61.1273	2.7169
Constituent in		N2	32.96	1.44	-	-	-	-	32.96	38.74	60.7423	1.0000	I58:N61	3.3936
Bubbles		N2O	4.08	0.19	3.39	0.17	2.72	3.39	4.08	4.86	61.8769	1.0000	I43:N46	4.0841
		CH4	1.62	0.09	9.26	0.43	1.25	1.62	9.26	10.96	71.6747	-		4.8554
		NH3	0.60	0.06	-	-	-	-	0.60	0.86	62 AN-103 H2 61.1273			
5		100.00		75.06						retainedGasCompositionNH3	0.6000		62 /	

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "4-Gas comp by tanks"

										retainedGasCompositionN2				53.7300	MEAN	AN-103 H2	31.1400	MEAN		
										headspaceGasRatioCH4				0.2100	STDDEV	AN-103 H2	4.3860	STDDEV		
										headspaceGasRatioN2O				0.1300					MEAN STDDEV	
Tank and Sample (or)										U-103										
U-103 solids		high salt range		low salt range		assumptions				H2		N2O								
		mean	std dev	mean	std dev	low	mean1	mean2	high											
Mole Percent of Constituent in Bubbles	H2	22.87	0.46	23.84	0.51	21.01	22.87	23.84	25.90	21.0142		-	23.4174	33.8427						
	N2	35.97	0.77	37.86	0.85	32.89	35.97	37.86	41.25	22.8687		1.0000	I71:N74	36.7458						
	N2O	38.79	0.79	36.75	0.73	33.84	36.75	38.79	41.96	23.8437		1.0000	I52:N55	38.7891						
	CH4	1.78	0.07	1.06	0.06	0.83	1.06	1.78	2.05	25.8985				41.9594						
	NH3	0.59	0.10	0.49	0.07	0.23	0.49	0.59	1.00	75 U-103 H2		23.4174								
1		100.00		100.00						retainedGasCompositionNH3		0.6000			75					
										retainedGasCompositionN2				53.7300	MEAN	5 U-103 H2	31.1400	MEAN		
										headspaceGasRatioCH4				0.2100	STDDEV	5 U-103 H2	1.0217	STDDEV		
										headspaceGasRatioN2O				0.1300					MEAN STDDEV	
Tank and Sample (or)										S-106										
S-106 solids		high salt range		low salt range		assumptions				H2		N2O								
		mean	std dev	mean	std dev	low	mean1	mean2	high											
Mole Percent of Constituent in Bubbles	H2	62.57	1.90	64.96	1.97	54.95	62.57	64.96	72.82	54.9544		-	63.8400	7.3625						
	N2	24.91	1.24	0.08	0.01	0.01	0.06	24.91	29.87	62.5667		1.0000	I84:N87	8.4011						
	N2O	10.96	0.34	8.40	0.28	7.36	8.40	10.96	12.32	64.9564		1.0000		10.9607						
	CH4	1.26	0.14	0.41	0.10	-	0.41	1.28	1.80	72.8187		-		12.3213						
	NH3	0.30	0.07	-	-	-	-	0.30	0.56	88 S-106 H2		63.8400								
2		100.00		74.67						retainedGasCompositionNH3		0.6000			86					
										retainedGasCompositionN2				53.7300	MEAN	8 S-106 H2	31.1400	MEAN		
										headspaceGasRatioCH4				0.2100	STDDEV	8 S-106 H2	3.6360	STDDEV		
										headspaceGasRatioN2O				0.1300					MEAN STDDEV	

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "4-Gas comp by tanks"

Tank and Sample (or		high salt range		low salt range		assumptions				BY-109		
BY-109		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O
Mole Percent of												
Constituent in												
Bubbles												
H2		47.86	1.87	51.03	1.87	40.40	47.86	51.03	58.52	40.3963	-	49.4537
N2		27.77	1.78	0.02	0.00	0.01	0.02	27.77	34.91	47.8594	1.0000	15.9951
N2O		17.15	0.84	18.00	0.75	12.99	18.00	17.15	20.50	51.0292	1.0000	17.1537
CH4		7.03	0.29	1.83	0.11	1.40	1.83	7.03	8.18	58.5226	-	20.5039
NH3		0.19	0.03	-	-	-	-	0.19	0.32			
3		100.00		100.00						101 BY-109 H2	49.4537	1
										retainedGasCompositionNH3	0.6000	101
										retainedGasCompositionN2	53.7300	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV
										headspaceGasRatioN2O	0.1300	MEAN
												STDDEV
Tank and Sample (or		high salt range		low salt range		assumptions				SX-106		
SX-106		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O
Mole Percent of												
Constituent in												
Bubbles												
H2		49.80	1.48	51.87	1.59	43.67	49.80	51.87	58.23	43.6717	-	50.8674
N2		19.81	1.24	20.99	1.36	1.74	2.41	5.45	7.01	49.5979	1.0000	1110:N113
N2O		23.78	0.92	-	-	-	-	23.78	27.48	51.8691	1.0000	23.7835
CH4		1.36	0.07	0.35	0.04	0.20	0.35	1.36	1.63	58.2261	-	27.4795
NH3		5.45	0.39	2.41	0.17	1.74	2.41	5.45	7.01			
4		100.00		75.99						114 SX-106 H2	50.8674	1
										retainedGasCompositionNH3	0.6000	114
										retainedGasCompositionN2	53.7300	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV
										headspaceGasRatioN2O	0.1300	MEAN
												STDDEV
Tank and Sample (or		high salt range		low salt range		assumptions				AX-101		
AX-101-9D-8		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O
Mole Percent of												
Constituent in												
Bubbles												
H2		80.10	1.81	83.98	1.90	52.88	80.10	83.98	71.59	52.8775	-	82.1805
N2		16.77	0.89	17.99	0.91	13.23	16.77	17.99	21.84	60.1029	1.0000	1123:N126
N2O		10.85	0.34	-	-	-	-	10.85	12.20	63.9822	1.0000	10.8512
CH4		3.97	0.21	3.29	0.13	2.78	3.29	3.97	4.79	71.5947	-	12.2019
NH3		8.30	0.65	4.30	0.32	3.02	4.30	8.30	10.89			
										127 AX-101 H2	62.1805	1

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

5		100.00		88.80												retainedGasCompositionNH3	0.6000			127	
																retainedGasCompositionN2	53.7300	MEAN	AX-101 H2	31.1400	MEAN
																headspaceGasRatioCH4	0.2100	STDDEV	AX-101 H2	3.8615	STDDEV
																headspaceGasRatioN2O	0.1300			MEAN	STDDEV
Tank and Sample (or S-102 tank avg)		high salt range		low salt range		assumptions				S-102											
		mean	std dev	mean	std dev	low	mean1	mean2	high	H2					N2O						
Mole Percent of Constituent in Bubbles	H2	33.08	1.05	34.94	1.04	28.88	33.08	34.94	39.10	28.8810					-	33.9988	27.1357				
	N2	31.99	1.41	33.00	1.51	26.36	31.99	33.00	39.06	33.0760					1.0000	1138:N139	30.8667				
	N2O	33.03	1.04	30.98	0.96	27.14	30.96	33.03	37.18	34.9445					1.0000		33.0252				
	CH4	0.81	0.06	0.50	0.02	0.42	0.50	0.81	1.00	38.1030					-		37.1824				
	NH3	1.10	0.14	0.80	0.07	0.33	0.80	1.10	1.84						140 S-102 H2	33.9988					
6		100.00		99.30												retainedGasCompositionNH3	0.6000			14C	
																retainedGasCompositionN2	53.7300	MEAN	0 S-102 H2	31.1400	MEAN
																headspaceGasRatioCH4	0.2100	STDDEV	0 S-102 H2	2.1742	STDDEV
																headspaceGasRatioN2O	0.1300			MEAN	STDDEV
Tank and Sample (or S-111 solids)		high salt range		low salt range		assumptions				S-111											
		mean	std dev	mean	std dev	low	mean1	mean2	high	H2					N2O						
Mole Percent of Constituent in Bubbles	H2	65.90	3.21	66.95	3.55	53.08	65.90	66.95	81.55	53.0769					-	67.0058	7.6752				
	N2	21.04	1.91	21.94	1.92	13.40	21.04	21.94	29.61	65.8981					1.0000	1149:N152	9.6339				
	N2O	11.05	0.59	9.83	0.49	7.68	9.63	11.05	13.39	66.9453					1.0000		11.0479				
	CH4	0.81	0.07	-	-	-	-	0.91	1.17	81.5507					-		13.3921				
	NH3	1.10	0.13	0.80	0.07	0.34	0.80	1.10	1.84						153 S-111 H2	67.0058					
7		100.00		80.10												retainedGasCompositionNH3	0.6000			153	
																retainedGasCompositionN2	53.7300	MEAN	3 S-111 H2	31.1400	MEAN
																headspaceGasRatioCH4	0.2100	STDDEV	3 S-111 H2	5.8283	STDDEV

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

Tank and Sample (or		high salt range		low salt range		assumptions				U-109				MEAN	
U-109 tank		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O		STDDEV	
Mole Percent of Constituent in Bubbles	H2	24.75	1.04	26.14	1.08	20.59	24.75	26.14	30.47	20.5904	-	25.4975	19.8594		
	N2	45.65	2.66	48.39	2.76	0.33	0.60	1.18	1.85	24.7512	1.0000	1162:N165	24.0682		
	N2O	26.73	1.17	24.07	1.05	19.86	24.07	26.73	31.40	26.1374	1.0000		26.7349		
	CH4	1.68	0.11	0.80	0.03	0.67	0.80	1.68	2.13	30.4683	-		31.4044		
	NH3	1.18	0.17	0.80	0.07	0.33	0.60	1.18	1.85	166 U-109 H2		25.4975			
8		100.00		99.40						retainedGasCompositionNH3	0.6000			166	
										retainedGasCompositionN2	53.7300	MEAN	6 U-109 H2	31.1400	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV	6 U-109 H2	1.9986	STDDEV
										headspaceGasRatioN2O	0.1300				MEAN
															STDDEV
Tank and Sample (or		high salt range		low salt range		assumptions				SY-101				MEAN	
SY-101 ave		mean	std dev	mean	std dev	low	mean1	mean2	high	H2		N2O		STDDEV	
Mole Percent of Constituent in Bubbles	H2	31.29	2.17	36.85	2.32	22.61	31.29	36.85	46.13	22.6097	-	34.2531	13.2448		
	N2	31.88	2.62	39.83	3.36	21.38	31.88	39.83	53.28	31.2949	1.0000	1175:N178	17.4790		
	N2O	21.82	1.60	17.48	1.06	13.24	17.48	21.82	28.31	36.8513	1.0000		21.9224		
	CH4	3.21	0.30	0.98	0.10	0.59	0.98	3.21	4.41	46.1337	-		28.3075		
	NH3	11.70	1.06	4.86	0.41	3.21	4.86	11.70	15.95	179 SY-101 H2		34.2531			
9		100.00		99.40						retainedGasCompositionNH3	0.6000			179	
										retainedGasCompositionN2	53.7300	MEAN	SY-101 H2	31.1400	MEAN
										headspaceGasRatioCH4	0.2100	STDDEV	SY-101 H2	5.1338	STDDEV
										headspaceGasRatioN2O	0.1300				MEAN
															STDDEV
Forecasts										1 AW-101 NH3	AW-101 NH3	AW-101 sol	31.6576		
										2 A-101 NH3	A-101 NH3	A-101 uppe	50.6499		
										3 AN-105 NH3	AN-105 NH3	AN-105 soli	60.8674		

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”, Tab “4-Gas comp by tanks”

Mole Percent of Constituent in Bubbles

4 AN-104	NH3	AN-104 NH3	AN-104 soli	45.6702
5 AN-103	NH3	AN-103 NH3	AN-103 soll	61.1273
6 U-103	NH3	U-103 NH3	U-103 solid	23.4174
7 S-106	NH3	S-106 NH3	S-106 solid	63.8400
8 BY-109	NH3	BY-109 NH3	BY-109 ber	49.4537
9 SX-106	NH3	SX-106 NH3	SX-106 soll	50.8674
10 AX-101	NH3	AX-101 NH3	AX-101-9D	62.1605
11 S-102	NH3	S-102 NH3	S-102 tank	33.9988
12 S-114	NH3	S-114 NH3	S-114 solid	67.0058
13 U-109	NH3	U-109 NH3	U-109 tank	25.4975
14 SY-101	NH3	SY-101 NH3	SY-101 ave	34.2531
Min			Min	-
Max			Max	41.9594
			Min	23.4174
			Max	67.0058

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

								H2	
								Row ==>	12 O
									Trials
									Mean
									Median
									Mode
									Standard C
									Variance
									Skewness
									Kurtosis
									Coeff. of V.
									Range Min
									Range Max
								Row ==>	24 O
									Trials
									Mean
									Median
									Mode
									Standard C
									Variance
									Skewness
									Kurtosis
									Coeff. of V.
									Range Min
									Range Max
								Row ==>	36 O
									Trials
									Mean
									Median
									Mode

RPP-10006 REV 7

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

36 AN-105 N2O	12.6131	36 AN-105 CH4	1.3702	36 AN-105 NH3	1.2940	36 AN-105 N2	23.8553	Standard C	3.3698
AN-105 R_N2O	0.1685	36 R_CH4	0.0220					Variance	11.3558
36 AN-105 N2C	6.0600	MEAN 36 AN-105 CH4	8.4700	MEAN 36 AN-105 N	0.6000	MEAN 36 AN-105	53.7300	Skewness	-0.03
36 AN-105 N2C	1.4296	STDDEV 36 AN-105 CH4	0.3469	STDDEV 36 AN-105 N	0.0649	STDDEV 36 AN-105	3.6349	Kurtosis	2.34
AN-105 R_N2O	0.1300	MEAN 36 R_CH4	0.2100					Coeff. of V	0.06
AN-105 R_N2O	0.0178	STDDEV 36 R_CH4	0.0056					Range Min	52.7813
								Range Max	66.7882

		CH4		NH3		N2		Row ==>	49 O
-	21.5408	1.3185	-	2.8060	-	2.5263		Trials	1000
1.0000	P45:R48	2.3378	1.0000	T45:V48	-	1.0000	X45:Z48	Mean	45.5987
1.0000	P34:R37	3.3131	1.0000	T34:V37	0.8840	1.0000	X34:Z37	Median	45.7040
-		4.2657	-	1.4119	-			Mode	-
49 AN-104 N2O	21.5408	49 AN-104 CH4	2.8060	49 AN-104 NH3	2.5263	49 AN-104 N2	27.4568	Standard C	4.3661
AN-104 R_N2O	0.3077	49 R_CH4	0.0579					Variance	19.0632
49 AN-104 N2C	6.0600	MEAN 49 AN-104 CH4	8.4700	MEAN 49 AN-104 N	0.6000	MEAN 49 AN-104	53.7300	Skewness	-0.06
49 AN-104 N2C	2.4500	STDDEV 49 AN-104 CH4	0.6511	STDDEV 49 AN-104 N	0.1337	STDDEV 49 AN-104	4.9184	Kurtosis	2.35
AN-104 R_N2O	0.1300	MEAN 49 R_CH4	0.2100					Coeff. of V	0.10
AN-104 R_N2O	0.0321	STDDEV 49 R_CH4	0.0139					Range Min	35.6334
								Range Max	56.1041

		CH4		NH3		N2		Row ==>	62 O
-	3.7665	1.2522	-	5.7850	-	6.7396		Trials	1000
1.0000	P58:R61	1.6156	1.0000	T58:V61	-	1.0000	X58:Z61	Mean	61.1509
1.0000	P43:R46	9.2563	1.0000	T43:V46	0.5967	1.0000	X43:Z46	Median	61.1759
-		10.9624	-	0.8550	-			Mode	-
62 AN-103 N2O	3.7665	62 AN-103 CH4	5.7850	62 AN-103 NH3	6.7396	62 AN-103 N2	22.5816	Standard C	4.3860
AN-103 R_N2O	0.0533	62 R_CH4	0.0865					Variance	19.2373

"rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls", Tab "4-Gas comp by tanks"

62 AN-103 N2C	6.0600	MEAN	62 AN-103 CH4	8.4700	MEAN	62 AN-103 N	0.6000	MEAN	62 AN-103	53.7300	Skewness	0.01
62 AN-103 N2C	0.4416	STDDEV	62 AN-103 CH4	2.5736	STDDEV	62 AN-103 N	0.0661	STDDEV	62 AN-103	5.1532	Kurtosis	2.40
4N-103 R_N2O	0.1300	MEAN	62 R_CH4	0.2100							Coeff. of V.	0.07
4N-103 R_N2O	0.0071	STDDEV	62 R_CH4	0.0356							Range Min	50.5034
											Range Max	71.3726
Row ==> 75 O												
-	37.8475	CH4	-	1.4322	NH3	-	0.5892	N2			Trials	1000
1.0000	P71:R74	0.8314	1.0000	T71:V74	0.2313	1.0000	X71:Z74				Mean	23.4438
1.0000	P52:R55	1.0576	1.0000	T52:V55	0.4944	1.0000	X52:Z55				Median	23.4259
-	2.0542		-		1.0001	-					Mode	---
75 U-103 N2O	37.8475	75 U-103 CH4	1.4322	75 U-103 NH3	0.5892	75 U-103 N2	36.7136				Standard C	1.0217
5 U-103 R_N2O	0.6037	75 R_CH4	0.0576								Variance	1.0438
75 U-103 N2O	6.0600	MEAN	75 U-103 CH4	8.4700	MEAN	75 U-103 N	0.6000	MEAN	75 U-103 N	53.7300	Skewness	0.03
75 U-103 N2O	1.7223	STDDEV	75 U-103 CH4	0.2897	STDDEV	75 U-103 N	0.1580	STDDEV	75 U-103 N	2.0176	Kurtosis	2.32
3 U-103 R_N2O	0.1300	MEAN	75 R_CH4	0.2100							Coeff. of V.	0.04
3 U-103 R_N2O	0.0152	STDDEV	75 R_CH4	0.0111							Range Min	21.1146
											Range Max	25.8652
Row ==> 88 O												
-	9.7700	CH4	-	0.8721	NH3	-	0.2666	N2			Trials	1000
1.0000	P84:R87	0.4110	1.0000	T84:V87	-	1.0000	X84:Z87				Mean	63.8677
1.0000	P62:R65	1.2598	1.0000	T62:V65	0.2982	1.0000	X62:Z65				Median	63.8747
-	1.8019		-		0.5615	-					Mode	---
88 S-106 N2O	9.7700	88 S-106 CH4	0.8721	88 S-106 NH3	0.2666	88 S-106 N2	25.2314				Standard C	3.6360
8 S-106 R_N2O	0.1312	88 R_CH4	0.0135								Variance	13.2203
88 S-106 N2O	6.0600	MEAN	88 S-106 CH4	8.4700	MEAN	88 S-106 N	0.6000	MEAN	88 S-106 N	53.7300	Skewness	0.03
88 S-106 N2O	1.1464	STDDEV	88 S-106 CH4	0.4001	STDDEV	88 S-106 N	0.0673	STDDEV	88 S-106 N	3.7891	Kurtosis	2.34
3 S-106 R_N2O	0.1300	MEAN	88 R_CH4	0.2100							Coeff. of V.	0.06
3 S-106 R_N2O	0.0150	STDDEV	88 R_CH4	0.0062							Range Min	55.4556

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

				Range Max 72.6088			
				Row ==> 101 O			
				Trials 1000			
				Mean 49.4113			
				Median 49.2762			
				Mode ---			
				Standard C 3.7146			
				Variance 13.7982			
				Skewness -0.01			
				Kurtosis 2.28			
				Coeff. of V 0.08			
				Range Min 40.8163			
				Range Max 58.0221			
				Row ==> 114 O			
				Trials 1000			
				Mean 50.89347			
				Median 50.75708			
				Mode ---			
				Standard C 2.992561			
				Variance 8.955424			
				Skewness 0.089372			
				Kurtosis 2.257485			
				Coeff. of V 0.0588			
				Range Min 43.90172			
				Range Max 57.8058			
				Row ==> 127 O			
				Trials 1000			
				Mean 62.1476			
				Median 62.0682			
				Mode ---			
				Standard C 3.8615			

RPP-10006 REV 7

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

AX-101 R_N2O	0.1045		127 R_CH4	0.0565					Variance	14.9112		
127 AX-101 N2	6.0600	MEAN	127 AX-101 CH4	8.4700	MEAN	127 AX-101	0.6000	MEAN	127 AX-101	53.7300	Skewness	0.06
127 AX-101 N2	0.3294	STDDEV	127 AX-101 CH4	0.4351	STDDEV	127 AX-101	1.7692	STDDEV	127 AX-101	4.2841	Kurtosis	2.25
AX-101 R_N2O	0.1300	MEAN	127 R_CH4	0.2100					Coeff. of V.	0.06		
AX-101 R_N2O	0.0080	STDDEV	127 R_CH4	0.0073					Range Min	53.4810		
									Range Max	71.3259		

	CH4		NH3		N2	Row ==>	140 O					
-	32.0635	0.4201	-	0.6853	0.3326	-	0.9282	Trials	1000			
1.0000	P136:R139	0.4987	1.0000	T136:V139	0.6978	1.0000	X136:Z139	Mean	33.9914			
1.0000		0.8095	1.0000		1.1005	1.0000		Median	34.0062			
-		1.0013	-		1.6408	-		Mode	---			
140 S-102 N2O	32.0635		140 S-102 CH4	0.6853	140 S-102 NH3	0.9282		Standard C	2.1742			
140 S-102 R_N2O	0.4806		140 R_CH4	0.0198				Variance	4.7272			
140 S-102 N2C	6.0600	MEAN	140 S-102 CH4	8.4700	MEAN	140 S-102 N	0.6000	MEAN	140 S-102 I	53.7300	Skewness	-0.01
140 S-102 N2C	2.0580	STDDEV	140 S-102 CH4	0.1340	STDDEV	140 S-102 N	0.2880	STDDEV	140 S-102 I	3.0736	Kurtosis	2.31
140 S-102 R_N2O	0.1300	MEAN	140 R_CH4	0.2100					Coeff. of V.	0.06		
140 S-102 R_N2O	0.0220	STDDEV	140 R_CH4	0.0040					Range Min	29.1613		
									Range Max	38.8988		

	CH4		NH3		N2	Row ==>	153 O					
-	10.4567	-	-	0.6959	0.3403	-	0.9292	Trials	1000			
1.0000	P149:R152	-	1.0000	T149:V152	0.6014	1.0000	X149:Z152	Mean	66.7076			
1.0000		0.9133	1.0000		1.0986	1.0000		Median	66.5125			
-		1.1744	-		1.6356	-		Mode	---			
153 S-111 N2O	10.4567		153 S-111 CH4	0.6959	153 S-111 NH3	0.9292		Standard C	5.8283			
153 S-111 R_N2O	0.1338		153 R_CH4	0.0103				Variance	33.9686			
153 S-111 N2C	6.0600	MEAN	153 S-111 CH4	8.4700	MEAN	153 S-111 N	0.6000	MEAN	153 S-111 I	53.7300	Skewness	0.09
153 S-111 N2C	1.1898	STDDEV	153 S-111 CH4	0.0647	STDDEV	153 S-111 N	0.2852	STDDEV	153 S-111 I	5.9532	Kurtosis	2.45

“rgs FinalSumTable Rev 1 Tab 6MC 030823 .xls”, Tab “4-Gas comp by tanks”

S-111 R_N2O	0.1300		MEAN	153 R_CH4	0.2100			Coeff. of V:	0.09
S-111 R_N2O	0.0167		STDDEV	153 R_CH4	0.0016			Range Min	53.2953
								Range Max	81.0610
-	25.5407	CH4	0.6665	-	1.3270	NH3	0.3331	-	1.0084
1.0000 P162:R165	0.8050	1.0000 T162:V165	0.6007	1.0000 X162:Z165	1.1834	1.0000	1.0000		
1.0000	1.6758	1.0000	1.1834	1.0000	1.8493	-			
-	2.1337	-	1.8493	-					
166 U-109 N2O	25.5407	166 U-109 CH4	1.3270	166 U-109 NH3	1.0064	166 U-109 N2	46.6283		
S U-109 R_N2O	0.4877	166 R_CH4	0.0495						
166 U-109 N2C	6.0600	MEAN 166 U-109 CH4	8.4700	MEAN 166 U-109 N	0.6000	MEAN 166 U-109 I	53.7300		
166 U-109 N2C	2.4395	STDDEV 166 U-109 CH4	0.3575	STDDEV 166 U-109 N	0.3279	STDDEV 166 U-109 I	3.1883		
S U-109 R_N2O	0.1300	MEAN 166 R_CH4	0.2100						
S U-109 R_N2O	0.0306	STDDEV 166 R_CH4	0.0133						
-	20.3360	CH4	0.5877	-	2.3158	NH3	3.2059	-	8.9931
1.0000 P175:R178	0.9847	1.0000 T175:V178	4.8567	1.0000 X175:Z178	11.8990	1.0000	1.0000		
1.0000	3.2083	1.0000	11.8990	1.0000	15.9497	-			
-	4.4115	-	15.9497	-					
79 SY-101 N2O	20.3360	179 SY-101 CH4	2.3158	179 SY-101 NH3	8.9931	179 SY-101 N2	34.1020		
SY-101 R_N2O	0.3574	179 R_CH4	0.0633						
179 SY-101 N2	6.0600	MEAN 179 SY-101 CH4	8.4700	MEAN 179 SY-101	0.6000	MEAN 179 SY-101	53.7300		
179 SY-101 N2	3.2064	STDDEV 179 SY-101 CH4	0.9013	STDDEV 179 SY-101	2.9869	STDDEV 179 SY-101	6.7839		
SY-101 R_N2O	0.1300	MEAN 179 R_CH4	0.2100						
SY-101 R_N2O	0.0491	STDDEV 179 R_CH4	0.0257						
AW-101 solids	5.7387	AW-101 solids CI	8.5870	AW-101 NH	0.5141				
A-101 upper N	5.5689	A-101 upper CH4	4.0991	A-101 NH3	2.0514				
AN-105 solids I	12.6131	AN-105 solids C-	1.3702	AN-105 NH3	1.2940				

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

AN-104 solids f	21.5408	AN-104 solids CH	2.8080	AN-104 NH3	2.5263
AN-103 solids f	3.7665	AN-103 solids CH	5.7850	AN-103 NH3	8.7396
U-103 solids N2	37.8475	U-103 solids CH4	1.4322	U-103 NH3	0.6892
S-106 solids N2	9.7700	S-106 solids CH4	0.8721	S-106 NH3	0.2866
BY-109 behigh	16.6814	BY-109 behigh ss	4.6200	BY-109 NH3	0.1711
SX-108 solids f	4.1514	SX-108 solids CH	0.8889	SX-108 NH3	4.1894
AX-101-9D-8 N	7.6844	AX-101-9D-8 CH	3.7220	AX-101 NH3	6.6646
S-102 tank avg	32.0935	S-102 tank avg. C	0.6853	S-102 NH3	0.9282
S-114 solids N2	10.4567	S-114 solids CH4	0.6959	S-114 NH3	0.9292
U-109 tank avg	25.5407	U-109 tank avg. C	1.3270	U-109 NH3	1.0064
SY-101 ave N2	20.3360	SY-101 ave CH4	2.3158	SY-101 NH3	8.9931
Min	Min	Min	Min	Min	Min
Max	Max	Max	Max	Max	Max
	10.9824		15.9497		
	3.7665		0.6853		0.1711
	37.8475		8.6670		8.9931

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

N2) CH4 NH3 N2				R_N2O R_CH4		Tank	Gas	Mean	Std Dev	Min	Max	Type
S	W	AA	AE	13 S	W							
1000	1000	1000	1000	1000	1000	AIW-101	N2	53.5503	2.7074	45.4532	62.0123	Normal
5.7606	8.5528	0.5706	53.5503	0.1256	0.2136	AIW-101	NH3	0.5706	0.0699	0.2715	0.9587	Normal
5.8013	8.5616	0.5753	53.5713	0.1256	0.2136	AIW-101	N2O Ratio	0.1256	0.0205	0.0779	0.1739	Normal
—	—	—	—	—	—	AIW-101	CH4 Ratio	0.2136	0.0210	0.1565	0.2751	Normal
0.9980	0.8482	0.0999	2.7074	0.0205	0.0210							
0.9960	0.7160	0.0100	7.3298	0.0004	0.0004							
-0.01	-0.01	0.01	0.00	0.02	0.07							
1.90	2.37	3.07	2.59	2.10	2.63							
0.17	0.10	0.18	0.05	0.16	0.10							
3.8339	6.5431	0.2715	45.4532	0.0779	0.1565							
7.9000	10.5557	0.9587	62.0123	0.1739	0.2751							
S	W	AA	AE	25 S	W	A-101	N2	19.0006	2.3255	11.3518	26.5940	Normal
1000	1000	1000	1000	#####	1000	A-101	NH3	2.4569	0.2953	1.2415	3.3466	Normal
5.5769	1.5018	2.4569	19.0006	0.071038	0.020601	A-101	N2O Ratio	0.0710	0.0063	0.0577	0.0844	Normal
5.5857	1.5047	2.4429	19.0320	0.071142	0.020606	A-101	CH4 Ratio	0.0206	0.0010	0.0177	0.0236	Normal
—	—	—	—	—	—							
0.4097	0.0552	0.2953	2.3255	0.005261	0.000975							
0.1678	0.0030	0.0872	5.4081	2.77E-05	9.5E-07							
-0.02	-0.08	0.03	-0.05	0.030571	-0.045602							
2.27	2.84	3.28	3.06	2.509441	2.875621							
0.07	0.04	0.12	0.12	0.074061	0.047322							
4.6567	1.3021	1.2415	11.3518	0.057656	0.017668							
6.5122	1.6906	3.3466	26.5940	0.084372	0.023642							
S	W	AA	AE	37 S	W	AN-105	N2	24.5713	3.6349	14.1684	34.3390	Normal
1000	1000	1000	1000	1000	1000	AN-105	NH3	0.5001	0.0649	0.3029	0.7618	Normal
12.6562	1.3838	0.5001	24.5713	0.16897	0.022226	AN-105	N2O Ratio	0.1690	0.0178	0.1246	0.2198	Normal
12.6099	1.4048	0.4980	24.4745	0.168387	0.022398	AN-105	CH4 Ratio	0.0223	0.0058	0.0108	0.0359	Normal
—	—	—	—	—	—							

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

1.4296	0.3469	0.0649	3.6349	0.017801	0.005617
2.0437	0.1203	0.0042	13.2122	0.000317	3.18E-05
0.07	-0.11	0.12	0.05	0.062049	-0.052725
2.15	2.00	3.04	2.70	2.425953	2.070183
0.11	0.25	0.13	0.15	0.105352	0.252341
9.8383	0.6186	0.3029	14.1664	0.124804	0.010641
15.7712	2.0888	0.7618	34.3390	0.219649	0.035899

S	W	AA	AE	50	S	W
1000	1000	1000	1000	1000	1000	1000
21.5176	2.8291	0.8820	29.1727	0.308064	0.058752	
21.4626	2.8696	0.8861	29.0970	0.307336	0.059095	
---	---	---	---	---	---	
2.4500	0.6511	0.1337	4.9184	0.032057	0.013932	
6.0023	0.4240	0.0179	24.1907	0.001028	0.000194	
0.09	-0.08	-0.07	0.02	0.130719	0.017435	
2.33	2.17	2.96	2.53	2.709504	2.34622	
0.11	0.23	0.15	0.17	0.10406	0.237128	
16.0419	1.3793	0.3767	14.3337	0.223149	0.026566	
27.3782	4.2057	1.2932	41.4358	0.401107	0.0987	

S	W	AA	AE	63	S	W
1000	1000	1000	1000	1000	1000	1000
3.7613	5.8310	0.5966	28.6602	0.053411	0.086029	
3.7417	5.8219	0.5978	28.5760	0.053069	0.087424	
---	---	---	---	---	---	
0.4416	2.5736	0.0861	5.1532	0.007096	0.035624	
0.1950	6.6236	0.0044	26.5559	5.04E-05	0.001269	

AN-104	N2	29.1727	4.9184	14.3337	41.4358	Normal
AN-104	NH3	0.8820	0.1337	0.3767	1.2932	Normal
AN-104	N2O Ratio	0.3081	0.0321	0.2231	0.4011	Normal
AN-104	CH4 Ratio	0.0588	0.0139	0.0266	0.0987	Normal

AN-103	N2	28.6602	5.1532	14.9119	42.8042	Normal
AN-103	NH3	0.5966	0.0861	0.4003	0.7619	Normal
AN-103	N2O Ratio	0.0534	0.0071	0.0374	0.0786	Normal
AN-103	CH4 Ratio	0.0860	0.0356	0.0216	0.1639	Normal

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

	0.13	0.01	-0.08	-0.04		0.25907	-0.032474												
	2.26	1.75	2.83	2.57		2.738004	1.83637												
	0.12	0.44	0.11	0.16		0.132655	0.414088												
	2.7835	1.3003	0.4003	14.9119		0.037432	0.021524												
	4.8238	10.7868	0.7818	42.8042		0.076807	0.163913												
S	W	AA	AE		76 S	W		U-103	N2	36.7114	2.0176	30.9455	42.5608	Normal					
	1000	1000	1000	1000		1000	1000	U-103	NH3	0.5960	0.1560	0.2463	0.9827	Normal					
	37.8238	1.4250	0.5860	38.7114		0.6032	0.057238	U-103	N2O Ratio	0.6032	0.0152	0.5809	0.6449	Normal					
	37.8124	1.4164	0.5887	38.7171		0.603535	0.057138	U-103	CH4 Ratio	0.0672	0.0111	0.0340	0.0820	Normal					
	---	---	---	---		---	---												
	1.7223	0.2897	0.1560	2.0176		0.015214	0.011062												
	2.9854	0.0838	0.0243	4.0707		0.000231	0.000122												
	0.01	0.03	0.15	-0.04		-0.002635	0.03386												
	2.30	1.83	2.33	2.59		2.604428	2.009707												
	0.05	0.20	0.26	0.05		0.025222	0.183275												
	33.9731	0.8448	0.2463	30.9455		0.560894	0.03398												
	41.8525	2.0322	0.9627	42.5608		0.644936	0.082005												
S	W	AA	AE		89 S	W		S-106	N2	25.2167	3.7891	15.2492	34.9225	Normal					
	1000	1000	1000	1000		1000	1000	S-106	NH3	0.2988	0.0673	0.0942	0.5200	Normal					
	9.7450	0.8718	0.2988	25.2167		0.130954	0.013483	S-106	N2O Ratio	0.1310	0.0150	0.0682	0.1685	Normal					
	9.6765	0.8727	0.3008	25.3057		0.130202	0.013815	S-106	CH4 Ratio	0.0135	0.0082	0.0002	0.0297	Normal					
	---	---	---	---		---	---												
	1.1464	0.4001	0.0673	3.7891		0.01501	0.008204												
	1.3143	0.1601	0.0045	14.3575		0.000225	3.85E-05												
	0.11	0.07	-0.08	-0.01		0.140827	0.104516												
	2.01	2.16	3.03	2.43		2.23079	2.241314												
	0.12	0.46	0.23	0.15		0.114616	0.480098												
	7.3941	0.0142	0.0942	15.2492		0.098175	0.000211												

G-46

RPP-10006 REV 7

“rgs FinalSumTable Rev 1 Tab_6MC 030823 .xls”,Tab “4-Gas comp by tanks”

0.1085	0.1893	3.1300	18.3533	6.48E-05	5.27E-05
-0.02	0.10	0.08	-0.10	0.1553	0.152108
2.87	2.12	2.11	2.48	2.413915	2.292104
0.03	0.12	0.27	0.26	0.056732	0.127623
9.9324	2.8278	3.0943	4.6480	0.121906	0.040168
11.9319	4.7405	10.7840	27.3917	0.163299	0.078391

S	W	AA	AE	141	S	W
1000	1000	1000	1000	1000	1000	1000
32.1438	0.6872	0.9317	32.2461	0.481049	0.019883	
32.1775	0.6856	0.9216	32.1659	0.480987	0.019694	
—	—	—	—	—	—	
2.0580	0.1340	0.2880	3.0736	0.022028	0.004036	
4.2354	0.0180	0.0830	9.4488	0.000485	1.63E-05	
0.03	0.11	0.17	0.00	0.067397	0.219662	
2.33	2.04	2.15	2.80	2.74117	2.165423	
0.06	0.20	0.31	0.10	0.045788	0.202997	
27.4178	0.4271	0.3470	23.8737	0.413828	0.011642	
37.0688	0.9930	1.6237	40.7194	0.548543	0.030686	

S	W	AA	AE	154	S	W
1000	1000	1000	1000	1000	1000	1000
10.4810	0.9126	0.9287	20.9901	0.134526	0.0136	
10.4608	0.9136	0.9043	21.1214	0.134671	0.013492	
—	—	—	—	—	—	
1.1898	0.0647	0.2852	5.9532	0.016671	0.001558	
1.4158	0.0042	0.0613	35.4405	0.000278	2.42E-06	
0.03	-0.13	0.19	-0.08	0.13788	0.35688	
2.31	3.01	2.17	2.40	2.727512	3.003592	

S-102	N2	32.2461	3.0736	23.9737	40.7194	Normal
S-102	NH3	0.9317	0.2880	0.3470	1.6237	Normal
S-102	N2O Ratio	0.4810	0.0220	0.4138	0.5485	Normal
S-102	CH4 Ratio	0.0199	0.0040	0.0116	0.0307	Normal

S-111	N2	20.9901	5.9532	4.5555	34.7510	Normal
S-111	NH3	0.9287	0.2852	0.3545	1.6035	Normal
S-111	N2O Ratio	0.1345	0.0167	0.0924	0.1900	Normal
S-111	CH4 Ratio	0.0136	0.0016	0.0098	0.0192	Normal

G-48

RPP-10006 REV 7

3. Setup forecasts in cells in rows 12, 13, 24, 25, 36, 37, 49, 50, 62, 63, 75, 76, 88, 89, 101, 102, 114, 115, 127, 128, 140, 141, 153, 154, 166, 167, 179, 180, and columns "O", "S", "W", "AA."
 - a. Clear any existing forecasts.
4. Run Crystal Ball for 1,000 trials.
5. Prepare Crystal Ball report.
6. Copy summary statistics from Crystal Ball report to columns "AH" through "AO."
 - a. Save assumption.
7. Final database distributions for the RGS tanks are given in rows "AQ" through "AW."

G2.4 CREATE DISTRIBUTIONS FOR NON-RGS TANKS

Create the Four Distributions Required to Specify the Retained Gas Distributions for Non-RGS Tanks

- Capture 1,000 data points from each RGS distribution, then reduce data down to 420 points for each gas including 30 points from each RGS tank.
- Determine the default N₂ distribution for non-RGS tanks.
- Assume that the first 30 data points from the 1,000 are random and represent the overall distribution for the tank.

Tab "5 - 'CB05all Tab_5mc RGS Forecast Values 030823 .xls'" (Note this tab is in separate spreadsheet)

Note: This spreadsheet is set up for 1,000 trials with the same variables as given in 'CB05all Tab_5mc RGS Forecast Values 030823.xls'

1. Extract forecast data from Crystal Ball using the menu items "RUN" "EXTRACT DATA."
2. Open spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' or a copy.
3. Copy all extracted data to tab "All Tab_5mc RGS Forecast Values."
4. On the following tab copy range 'Q5:Q424' to 'R5:R424' and 'S5:S424' using "Paste Special" "values."
 - a. Use tabs "H₂", "N₂O", "CH₄", "NH₃" and "N₂."
5. On Tab "N₂" regress all 420 combined data points for N₂ to produce a combined distribution using Crystal Ball.
 - a. Create a distribution using Crystal Ball to fit the data by:
 - 1.) Create assumption.
 - 2.) Select fit data.

- 3.) Enter range of data, S5:S424.
 - 4.) Allow Crystal Ball to fit the data to the regression curves.
- Reduce the 420 data points for “H2”, “N2O”, “CH4”, “NH3” and the minimum and maximum values from all 16,000 data points for each gas to produce continuous linear distribution made up of 55 data pairs.
 - Use every eighth data point from the 420 combined points, following numerical sorting of the values, to define 53 of the data pairs.
 - Use the minimum and maximum data points as the bounding values for the continuous linear distributions

Tab “6- Gas Forecast Data”

1. Copy from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' to this spreadsheet, tab “6- Gas Forecast Data.”
 - a. For H2 - from range 'S5:S424 in tab “H2” to 'b5:b424' using “Paste Special” “values.”
 - b. For N2O - from range 'S5:S424 in tab “N2O” to 'k5:k424' using “Paste Special” “values.”
 - c. For CH4 - from range 'S5:S424 in tab “CH4” to 't5:t424' using “Paste Special” “values.”
 - d. For NH3 - from range 'S5:S424 in tab “NH3” to 'ac5:ac424' using “Paste Special” “values.”
2. Sort the raw data as given below.
 - a. For H2 - sort range a5:c424 with sort keys: 1 -- column C descending; 2 -- column A ascending; 3 -- NONE.
 - b. For N2O - sort range J5:L424 with sort keys: 1 -- column J descending; 2 -- column L ascending; 3 -- NONE.
 - c. For CH4 - sort range S5:U424 with sort keys: 1 -- column U descending; 2 -- column S ascending; 3 -- NONE.
 - d. For NH3 - sort range AB5:AD424 with sort keys: 1 -- column AD descending; 2 -- column AB ascending; 3 -- NONE.
3. Sort columns based on mask in columns to the right of the original data
 - a. For H2 -
 - 1.) Copy range B5:B57 to range D7:D59.
 - 2.) Copy H2 minimum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O39' in tab H2 to this spreadsheet in tab “6- Gas Forecast Data” cell 'D6.'

- 3.) Copy H2 maximum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O40' in tab H2 to this spreadsheet in tab "6- Gas Forecast Data" cell 'D60.'
- b. For N2O -
 - 1.) Copy range K5:K57 to range M7:M59.
 - 2.) Copy N2O minimum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O39' in tab N2O to this spreadsheet in tab "6- Gas Forecast Data" cell 'M6.'
 - 3.) Copy N2O maximum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O40' in tab N2O to this spreadsheet in tab "6- Gas Forecast Data" cell 'M60.'
- c. For CH4 -
 - 1.) Copy range T5:T57 to range V7:V59.
 - 2.) Copy CH4 minimum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O39' in tab CH4 to this spreadsheet in tab "6- Gas Forecast Data" cell 'V6.'
 - 3.) Copy CH4 maximum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O40' in tab CH4 to this spreadsheet in tab "6- Gas Forecast Data" cell 'V60.'
- a. For NH3 -
 - 1.) Copy range AC5:AC57 to range AE7:AE59.
 - 2.) Copy NH3 minimum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O39' in tab NH3 to this spreadsheet in tab "6- Gas Forecast Data" cell 'AE6.'
 - 3.) Copy NH3 maximum from the spreadsheet 'CB05all Tab_5mc RGS Forecast Values 030823 .xls' cell 'O40' in tab NH3 to this spreadsheet in tab "6- Gas Forecast Data" cell 'AE60.'
4. Sort the raw data as given below
 - a. For H2 - sort range a5:c424 with sort keys: 1 -- column A ascending; 2 -- NONE; 3 -- NONE.
 - b. For N2O - sort range J5:L424 with sort keys: 1 -- column L ascending; 2 -- NONE; 3 -- NONE.
 - c. For CH4 - sort range S5:U424 with sort keys: 1 -- column S ascending; 2 -- NONE; 3 -- NONE.
 - d. For NH3 - sort range AB5:AD424 with sort keys: 1 -- column AB ascending; 2 -- NONE; 3 -- NONE.

Calculate the "CH4 Ratio" and "N2O Ratio" distributions

5. Calculate distributions for "CH4 Ratio" and "N2O Ratio."

- a. Create Assumption Distributions for H₂, N₂O, CH₄, and NH₃ in cells H6, Q6, Z6, and AI6.
 - 1.) Use the Continuous Linear function.
 - a.) Select Create Assumption.
 - b.) Select Custom Distribution.
 - c.) Select Data.
 - d.) Enter range of data I.e., d6:e60 for H₂ and make sure the “cumulative data” selection is selected.
 - e.) Select “OK” to create the distribution.
- b. Create forecasts for “N₂”, “CH₄ Ratio” and “N₂O Ratio” values.
 - 1.) The formulas behind the forecasts are:
 - a.) For N₂: $100 - [H_2] - [N_2O] - [CH_4] - [NH_3]$.
 - b.) For “CH₄ Ratio”: $[CH_4] / ([CH_4] + [H_2])$.
 - c.) For “N₂O Ratio”: $[N_2O] / ([N_2O] + [CH_4] + [H_2])$.
 - 2.) Extract data for “CH₄ Ratio” and “N₂O Ratio” and copy to TAB “7-OverallDistributions.”

TAB “7-OverallDistributions”

1. Use Crystal Ball to fit 1,000 trails of data into distribution for “CH₄ Ratio” and “N₂O Ratio.”
 - a. Create a distribution using Crystal Ball to fit the data by:
 - 1.) Create Assumption.
 - 2.) Select fit Data.
 - 3.) Enter range of data.
 - a.) For “CH₄ Ratio” use the range B8:B1007.
 - b.) For “N₂O Ratio” use the range C8:C1007.
 - 4.) Allow Crystal Ball to fit the data to the regression curves.

G2.5 REFORMAT RESULTS TO FIT DATABASE

Tab “8-RPP-10006 DB values”

1. For RGS Tanks copy data values from tab “4-Gas comp by tanks” range AQ7:AW178 to tab “8-RPP-10006 DB values” cell A4.
2. Remove blank lines and sort by tank name.
3. When positioned as given in tab “8-RPP-10006 DB values” the numbers will automatically be rearranged to fit the database format by the embedded formulas.

4. The same procedure is used for the values for the default gas composition specifications.

G3.0 RESULTS

Table G.3.1 presents the distributions obtained by the methodology explained in Section G2.0. Included in the results are the gas concentration distributions for all 16 RGS tanks as well as the gas concentration distributions for non-RGS tanks, which are labeled "DEFAULT". Following Table G.3.1 are three figures illustrating the distributions overlaying the frequency bins for the DEFAULT distributions, demonstrating the closeness of fit achieved Crystal Ball by its regression algorithm.

Table G.3.1. Retained Gas Concentration Distribution Results. (2 sheets)

Tank	Gas	Mean	Std Dev	Min	Max	Distribution Type
A-101	CH4 Ratio	0.0206	0.0010	0.0177	0.0236	Normal
A-101	N2	19.0006	2.3255	11.3516	26.5940	Normal
A-101	N2O Ratio	0.0710	0.0053	0.0577	0.0844	Normal
A-101	NH3	2.4569	0.2953	1.2415	3.3466	Normal
AN-103	CH4 Ratio	0.0860	0.0356	0.0215	0.1639	Normal
AN-103	N2	28.6602	5.1532	14.9119	42.8042	Normal
AN-103	N2O Ratio	0.0534	0.0071	0.0374	0.0768	Normal
AN-103	NH3	0.5966	0.0661	0.4003	0.7819	Normal
AN-104	CH4 Ratio	0.0588	0.0139	0.0266	0.0987	Normal
AN-104	N2	29.1727	4.9184	14.3337	41.4358	Normal
AN-104	N2O Ratio	0.3081	0.0321	0.2231	0.4011	Normal
AN-104	NH3	0.8820	0.1337	0.3767	1.2932	Normal
AN-105	CH4 Ratio	0.0223	0.0056	0.0108	0.0359	Normal
AN-105	N2	24.5713	3.6349	14.1664	34.3390	Normal
AN-105	N2O Ratio	0.1690	0.0178	0.1246	0.2198	Normal
AN-105	NH3	0.5001	0.0649	0.3029	0.7618	Normal
AW-101	CH4 Ratio	0.2136	0.0210	0.1565	0.2751	Normal
AW-101	N2	53.5503	2.7074	45.4532	62.0123	Normal
AW-101	N2O Ratio	0.1256	0.0205	0.0779	0.1739	Normal
AW-101	NH3	0.5706	0.0999	0.2715	0.9587	Normal
AX-101	CH4 Ratio	0.0568883	0.0072603	0.040168	0.0763907	Normal
AX-101	N2	16.682515	4.2840712	4.6480254	27.391705	Normal
AX-101	N2O Ratio	0.1417203	0.0080401	0.1219057	0.1632994	Normal
AX-101	NH3	6.5851237	1.769175	3.094251	10.784005	Normal

Table G.3.1. Retained Gas Concentration Distribution Results. (2 sheets)

Tank	Gas	Mean	Std Dev	Min	Max	Distribution Type
BY-109	CH4 Ratio	0.0857066	0.0312712	0.0277509	0.1608994	Normal
BY-109	N2	29.044525	4.4366125	16.677941	42.376593	Normal
BY-109	N2O Ratio	0.2362124	0.0213373	0.1780785	0.3050799	Normal
BY-109	NH3	0.1912388	0.0337871	0.081167	0.3206144	Normal
S-102	CH4 Ratio	0.0198833	0.0040362	0.0116416	0.0306858	Normal
S-102	N2	32.246089	3.0735677	23.973682	40.719438	Normal
S-102	N2O Ratio	0.4810489	0.0220261	0.4138286	0.5485435	Normal
S-102	NH3	0.9317253	0.2880169	0.3470069	1.6237296	Normal
S-106	CH4 Ratio	0.0134833	0.0062037	0.000211	0.0296648	Normal
S-106	N2	25.216722	3.7891284	15.249227	34.922471	Normal
S-106	N2O Ratio	0.1309545	0.0150095	0.0981745	0.1694995	Normal
S-106	NH3	0.2988262	0.0672631	0.0941543	0.5200336	Normal
S-111	CH4 Ratio	0.0136002	0.0015555	0.0097731	0.0192358	Normal
S-111	N2	20.990104	5.9531917	4.5555037	34.751033	Normal
S-111	N2O Ratio	0.1345261	0.0166708	0.0924325	0.1900213	Normal
S-111	NH3	0.9286594	0.2851553	0.354503	1.6034667	Normal
SX-106	CH4 Ratio	0.0170592	0.0069497	0.0046007	0.0339737	Normal
SX-106	N2	20.202874	3.4462161	10.197908	29.550656	Normal
SX-106	N2O Ratio	0.3154821	0.0150306	0.2752638	0.3600094	Normal
SX-106	NH3	4.2022214	1.2553005	1.7899067	6.8047356	Normal
SY-101	CH4 Ratio	0.0650518	0.0257035	0.0145888	0.1498403	Normal
SY-101	N2	33.874694	6.7839154	13.359652	53.313162	Normal
SY-101	N2O Ratio	0.360501	0.0490851	0.226125	0.5012775	Normal
SY-101	NH3	9.1721	2.9868881	3.2737398	15.767285	Normal
U-103	CH4 Ratio	0.0572362	0.0110623	0.0339797	0.0820054	Normal
U-103	N2	36.711397	2.0175933	30.945456	42.560795	Normal
U-103	N2O Ratio	0.6032003	0.015214	0.5608941	0.644936	Normal
U-103	NH3	0.5959713	0.1560355	0.2463287	0.9627055	Normal
U-109	CH4 Ratio	0.0489471	0.0133258	0.0238921	0.0873525	Normal
U-109	N2	46.777093	3.1883437	36.853937	56.618098	Normal
U-109	N2O Ratio	0.4889364	0.0306199	0.4021244	0.5769073	Normal
U-109	NH3	1.0070756	0.3279163	0.3542088	1.8118107	Normal
DEFAULT	CH4 Ratio	0.0529	0.0563	0.0010	0.3178	LogNorm
DEFAULT	N2	29.84	12.01	4.5000	80.0000	LogNorm
DEFAULT	N2O Ratio	0.2533	0.1758	0.0010	0.6189	LogNorm

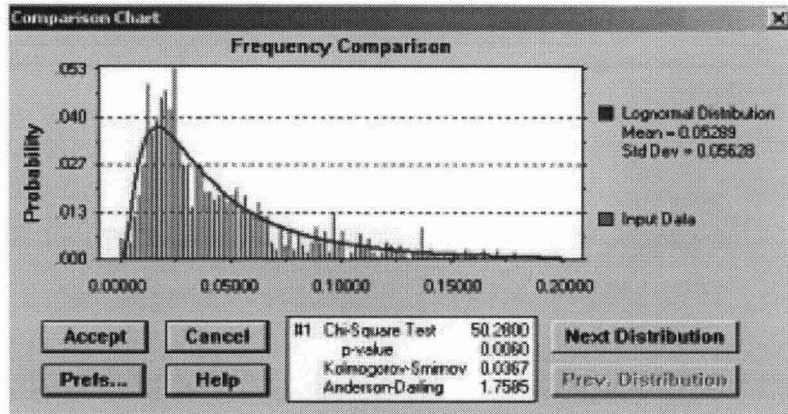
Figure G.3.1. Distribution fit of CH₄ Ratio

R_CH4 0.03526

Mean 5.2890E-02
Std Dev 5.6280E-02

Log Mean -3.3182E+00
Log Std Dev 8.7019E-01

Min 1.0000E-03
Max 0.3178

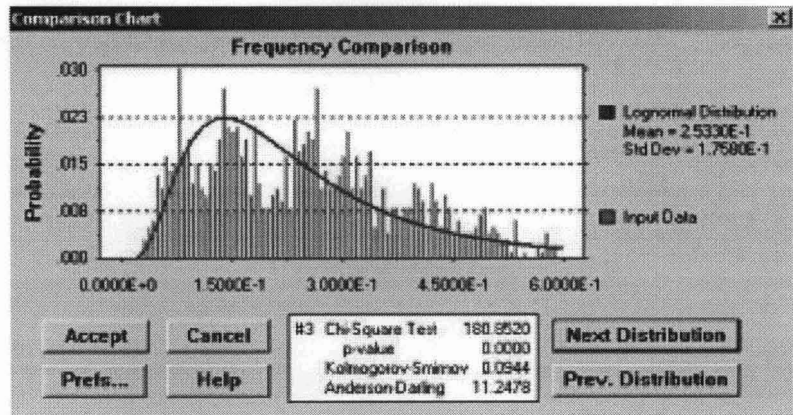
Figure G.3.2. Distribution fit of N₂O Ratio

R_N2O 2.3960E-01

Mean 2.53E-01
Std Dev 1.76E-01

Log Mean -1.57E+00
Log Std Dev 6.27E-01

Min 1.0000E-03
Max 0.6189

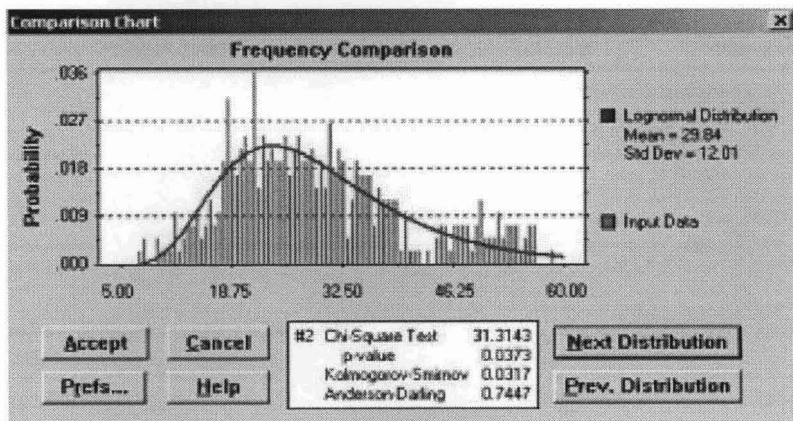
Figure G.3.3. Distribution fit of N₂ Concentration

N2 Distribu 50 d8:s427

LogNormal

Mean 29.84
StdDev 12.01

Min 4.5
Max 80



G4.0 REFERENCES

PNNL-13317, 2000, "*Ammonia Results Review for Retained Gas Sampling*", Pacific Northwest National Laboratory, Richland, Washington.

APPENDIX H

INPUT DATA

This page intentionally left blank.

CONTENTS

H1.0	PURPOSE.....	H-1
H2.0	INPUT DATA	H-1
H3.0	USE OF COMPUTER SOFTWARE	H-2
H4.0	REFERENCES	H-28

LIST OF TERMS

DST	double-shell tank
LIQ	liquid waste form
MIX-LIQ	mixed waste form with ≥ 1 m liquid over solids
MIX-NL	mixed waste form with < 1 m liquid over solids
n/a	not applicable
OSD	operating specifications documents
PCSACS ILL	Personal Computer Surveillance Analysis Computer System Interstitial Liquid Level
SC/SS	saltcake/salt slurry
SC/SS-LIQ	saltcake/salt slurry waste form with ≥ 1 m liquid over solids
SC/SS-NL	saltcake/salt slurry waste form with < 1 m liquid over solids
SL	sludge
SL-LIQ	sludge waste form with ≥ 1 m liquid over solids
SL-NL	sludge waste form with < 1 m liquid over solids
SST	single shell tank
vol%	volume percent

APPENDIX H

INPUT DATA

H1.0 PURPOSE

This appendix presents the input data used to perform the flammable gas waste group assignment calculations. Updated input data for evaluation of all double-shell tanks and 17 single-shell tanks has been incorporated into the input data table. Data for the remaining single-shell tanks remain current or bounding; therefore, re-evaluation was not required for these tanks. The calculation methodology is discussed in Section 3.0 of the main text with the waste group assignment calculation results presented in Section 5.0.

H2.0 INPUT DATA

Input data are presented in this appendix. Input data sources are shown in the "Reference" row. Updated information in the input data table is taken from RPP-5926 or from RPP-10006, Rev. 5, except the DST non-convective waste levels and uncertainties, which are from Appendix C.

Selection of single-shell tanks to be reevaluated is based on review of BBI changes. Changes were identified as data published between the BBI query used for RPP-5926, Rev. 6 (September 27, 2006) and the query used for RPP-5926, Rev. 7 (September 17, 2007). Tanks with updated information are identified with an asterisk (*).

The BBI lists double-shell tanks 241-AP-101, 241-AP-104, and 241-AP-107 as having no solids; therefore, RPP-5926 R7 does not contain input data for the solids layers in these tanks. Input data for the solids in these tanks were carried through from RPP-10006, Rev. 5, which assumed tanks 241-AP-104 and 241-AP-107 contain some solids.

Tank 241-AP-106 also is listed in the BBI as having no solids; however, the tank is now assumed to contain solids. This assumption is based on new information (see Appendix C). No characterization information about the assumed solids is available. Therefore, tank 241-AP-106 solids will be assumed to be the same as tank 241-AP-104 solids in this evaluation.

Although tank 241-AP-101 is assumed to contain no solids, a nominal solid phase HGR was assigned to the tank to allow evaluation with the waste group model.

For the single-shell tanks that were not updated, information in the input data table is from the “MC_Data” worksheet in the data rebuild spreadsheet: RPP-10006 Rev 5 Data Rebuild 060306.xls. The data rebuild spreadsheet was verified (SVF-1118, *Spreadsheet Verification & Release Form for Spreadsheet RPP-10006 Rev 5 Data Rebuild 060306.xls*). The worksheets used and assumptions applied to generate the “MC_Data” sheet are described in RPP-29167, *Spreadsheet Description Document for RPP-10006 Rev 5 Data Rebuild 060306.xls*. Spreadsheet inputs used to generate RPP-10006 Rev 5 Data Rebuild 060306.xls are depicted in the Figure 3-1 hierarchy in the main text.

H3.0 USE OF COMPUTER SOFTWARE

The input data shown from the “MC_Data” worksheet are included in the RPP-10006 Rev 5 Data Rebuild 060306.xls spreadsheet. Additional spreadsheet information follows below.

Spreadsheet Verification Form Number: SVF-1118

Base Software: Microsoft Excel¹ 2003

Spreadsheet Title: RPP-10006 Rev 5 Data Rebuild 060306.xls.

Document: RPP-29167

Author: V. S. Anda

Purpose: Compilation of tank property data and source of data for RPP-10006 database

¹ Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

Data Source		RPP-5926 R7 (Table B-2), RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5, RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5
Tank #	Tank Type	Total waste depth (m)	Total waste depth uncertainty (m)	Total non- convective waste depth (m)	Total non- convective waste depth uncertainty (m)	Total non- convective waste depth lower bound (m)	Wetted non- convective waste depth (m)	Wetted non- convective waste depth uncertainty (m)	Wetted non- convective waste depth lower bound (m)	Mean Crust depth (m)	Convective Waste Density Mean (kg/m3)	Convective Waste Density Std Dev (kg/m3)	Convective Waste Density Min (kg/m3)	Convective Waste Density Max (kg/m3)	Convective Waste Density Dist (kg/m3)	Non- Convective Waste Density Mean (kg/m3)	Non- Convective Waste Density Std Dev (kg/m3)
A-101*	SST	2.95	0.292	2.95	0.292	0.010	2.95	0.292	0.010	0.00	1490	88	1318	1662	normal	1,700	128
A-102	SST	0.37	0.006	0.34	0.292	0.010	0.34	0.292	0.010	0.00	1570	93	1388	1752	normal	1,669	126
A-103	SST	3.50	0.006	3.46	0.292	0.010	3.46	0.292	0.010	0.00	1510	89	1335	1685	normal	1,750	132
A-104	SST	0.26	0.292	0.26	0.292	0.010	0.26	0.292	0.000	0.00	1640	97	1450	1830	normal	1,750	132
A-105	SST	0.34	0.292	0.34	0.292	0.000	0.34	0.292	0.000	0.00	1100	65	1000	1227	normal	1,540	116
A-106	SST	0.73	0.292	0.73	0.292	0.010	0.49	0.024	0.010	0.00	1100	65	1000	1227	normal	1,700	128
AN-101*	DST	10.54	0.006	0.47	0.25	0.01	0.47	0.25	0.01	0.00	1400	114	1176	1624	normal	1549	101
AN-102*	DST	9.82	0.006	1.58	0.34	0.01	1.58	0.34	0.01	0.00	1410	115	1184	1636	normal	1530	99
AN-103*	DST	8.84	0.080	3.78	0.29	0.01	3.78	0.29	0.01	0.89	1480	121	1243	1717	normal	1720	112
AN-104*	DST	9.71	0.035	4.14	0.31	0.01	4.14	0.31	0.01	0.41	1400	114	1176	1624	normal	1590	103
AN-105*	DST	10.38	0.050	4.50	0.15	0.01	4.50	0.15	0.01	0.45	1420	116	1193	1647	normal	1570	102
AN-106*	DST	6.52	0.006	2.57	0.25	0.01	2.57	0.25	0.01	0.00	1110	91	1000	1288	normal	1484	96
AN-107*	DST	10.16	0.006	2.28	0.10	0.01	2.28	0.10	0.01	0.00	1430	117	1201	1659	normal	1480	96
AP-101*	DST	10.66	0.006	0.00	0.25	0.00	0.00	0.25	0.00	0.00	1220	100	1025	1415	normal	1750	114
AP-102*	DST	10.08	0.006	0.52	0.25	0.01	0.52	0.25	0.01	0.00	1390	113	1168	1612	normal	1750	114
AP-103*	DST	7.01	0.006	0.35	0.02	0.01	0.35	0.02	0.01	0.00	1370	112	1151	1589	normal	1680	109
AP-104*	DST	10.12	0.006	0.35	0.25	0.01	0.35	0.25	0.01	0.00	1280	104	1075	1485	normal	1610	105
AP-105*	DST	10.48	0.006	1.15	0.14	0.01	1.15	0.14	0.01	0.00	1270	104	1067	1473	normal	1610	105
AP-106*	DST	10.48	0.006	0.24	0.25	0.01	0.24	0.25	0.01	0.00	1210	99	1016	1404	normal	1610	105
AP-107*	DST	10.41	0.006	0.32	0.25	0.01	0.32	0.25	0.01	0.00	1280	104	1075	1485	normal	1610	105
AP-108*	DST	11.50	0.006	0.98	0.47	0.01	0.98	0.47	0.01	0.00	1410	115	1184	1636	normal	1550	101
AW-101*	DST	10.40	0.100	2.84	0.29	0.01	2.84	0.29	0.01	0.80	1470	120	1235	1705	normal	1590	103
AW-102*	DST	9.96	0.006	0.57	0.25	0.01	0.57	0.25	0.01	0.00	1070	87	1000	1241	normal	1600	104
AW-103*	DST	10.11	0.006	3.11	0.16	0.01	3.11	0.16	0.01	0.00	1240	101	1042	1438	normal	1489	97
AW-104*	DST	9.86	0.006	2.29	0.50	0.01	2.29	0.50	0.01	0.00	1350	110	1134	1566	normal	1485	96
AW-105*	DST	3.85	0.006	2.42	0.31	0.01	2.42	0.31	0.01	0.00	1040	85	1000	1206	normal	1332	87
AW-106*	DST	10.44	0.006	2.75	0.36	0.01	2.75	0.36	0.01	0.00	1220	100	1025	1415	normal	1770	115
AX-101	SST	3.30	0.292	3.30	0.292	0.010	1.71	0.024	0.000	0.00	1100	65	1000	1227	normal	1,702	128
AX-102	SST	0.28	0.292	0.28	0.292	0.010	0.28	0.292	0.000	0.00	1100	65	1000	1227	normal	1,578	119
AX-103	SST	0.98	0.292	0.98	0.292	0.010	0.84	0.024	0.010	0.00	1100	65	1000	1227	normal	1,580	119
AX-104*	SST	0.07	0.292	0.07	0.292	0.010	0.07	0.292	0.000	0.00	1170	69	1035	1305	normal	1,800	136
AY-101*	DST	7.67	0.006	1.04	0.08	0.01	1.04	0.08	0.01	0.00	1130	92	1000	1311	normal	1684	109
AY-102*	DST	9.22	0.006	1.63	0.12	0.01	1.63	0.12	0.01	0.00	1290	105	1084	1496	normal	1592	104
AZ-101*	DST	7.77	0.006	0.60	0.15	0.01	0.60	0.15	0.01	0.00	1240	101	1042	1438	normal	1610	105
AZ-102*	DST	8.79	0.006	1.13	0.25	0.01	1.13	0.25	0.01	0.00	1130	92	1000	1311	normal	1410	92
B-101	SST	1.19	0.292	1.19	0.292	0.010	1.19	0.292	0.010	0.00	1100	65	1000	1227	normal	1,489	112
B-102	SST	0.48	0.006	0.45	0.292	0.010	0.45	0.292	0.010	0.00	1260	74	1114	1406	normal	1,612	122

Data Source		RPP-5926 R7 (Table B-2), RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5, RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5
Tank #	Tank Type	Total waste depth (m)	Total waste depth uncertainty (m)	Total non- convective waste depth (m)	Total non- convective waste depth uncertainty (m)	Total non- convective waste depth lower bound (m)	Wetted non- convective waste depth (m)	Wetted non- convective waste depth uncertainty (m)	Wetted non- convective waste depth lower bound (m)	Mean Crust depth (m)	Convective Waste Density Mean (kg/m3)	Convective Waste Density Std Dev (kg/m3)	Convective Waste Density Min (kg/m3)	Convective Waste Density Max (kg/m3)	Convective Waste Density Dist (kg/m3)	Non- Convective Waste Density Mean (kg/m3)	Non- Convective Waste Density Std Dev (kg/m3)
B-103	SST	0.70	0.292	0.70	0.292	0.010	0.70	0.292	0.000	0.00	1100	65	1000	1227	normal	1,613	122
B-104	SST	3.65	0.292	3.65	0.292	0.010	3.60	0.024	0.010	0.00	1100	65	1000	1227	normal	1,385	105
B-105	SST	2.87	0.292	2.87	0.292	0.010	1.19	0.024	0.010	0.00	1100	65	1000	1227	normal	1,653	125
B-106	SST	1.32	0.006	1.31	0.292	0.010	1.31	0.292	0.010	0.00	1260	74	1114	1406	normal	1,381	104
B-107	SST	1.68	0.292	1.68	0.292	0.010	1.65	0.024	0.010	0.00	1100	65	1000	1227	normal	1,626	123
B-108	SST	1.04	0.292	1.04	0.292	0.010	0.89	0.024	0.010	0.00	1100	65	1000	1227	normal	1,676	127
B-109	SST	1.34	0.292	1.34	0.292	0.010	1.07	0.024	0.010	0.00	1100	65	1000	1227	normal	1,783	135
B-110	SST	2.46	0.006	2.45	0.292	0.010	2.41	0.024	0.010	0.00	1190	70	1052	1328	normal	1,360	103
B-111	SST	2.42	0.006	2.41	0.292	0.010	2.22	0.024	0.010	0.00	1190	70	1052	1328	normal	1,270	96
B-112	SST	0.51	0.006	0.48	0.292	0.010	0.48	0.292	0.010	0.00	1510	89	1335	1685	normal	1,750	132
B-201	SST	4.02	0.292	4.02	0.292	0.010	4.02	0.292	0.000	0.00	1100	65	1000	1227	normal	1,260	95
B-202*	SST	3.77	0.292	3.77	0.292	0.010	3.77	0.292	0.000	0.00	1170	69	1035	1305	normal	1,220	92
B-203	SST	6.73	0.006	6.66	0.292	0.010	6.66	0.292	0.010	0.00	1050	62	1000	1171	normal	1,190	90
B-204	SST	6.62	0.006	6.52	0.292	0.010	6.52	0.292	0.010	0.00	1050	62	1000	1171	normal	1,190	90
BX-101	SST	0.63	0.292	0.63	0.292	0.010	0.63	0.292	0.000	0.00	1100	65	1000	1227	normal	1,680	127
BX-102*	SST	0.92	0.292	0.92	0.292	0.010	0.92	0.292	0.000	0.00	1170	69	1035	1305	normal	1,750	114
BX-103*	SST	0.88	0.006	0.76	0.292	0.010	0.76	0.292	0.010	0.00	1070	63	1000	1194	normal	1,661	125
BX-104	SST	1.12	0.006	1.09	0.292	0.010	1.09	0.292	0.010	0.00	1280	76	1132	1428	normal	1,680	127
BX-105	SST	0.85	0.006	0.81	0.292	0.010	0.81	0.292	0.010	0.00	1290	76	1141	1439	normal	1,694	128
BX-106*	SST	0.54	0.292	0.54	0.292	0.010	0.54	0.292	0.000	0.00	1170	69	1035	1305	normal	1,617	122
BX-107	SST	3.39	0.292	3.39	0.292	0.010	3.39	0.292	0.000	0.00	1100	65	1000	1227	normal	1,440	109
BX-108	SST	0.48	0.292	0.48	0.292	0.010	0.48	0.292	0.000	0.00	1100	65	1000	1227	normal	1,457	110
BX-109	SST	1.97	0.292	1.97	0.292	0.010	1.97	0.292	0.010	0.00	1100	65	1000	1227	normal	1,520	115
BX-110	SST	2.17	0.006	2.16	0.292	0.010	2.16	0.292	0.010	0.00	1440	85	1273	1607	normal	1,667	126
BX-111	SST	1.93	0.292	1.93	0.292	0.010	1.11	0.024	0.010	0.00	1100	65	1000	1227	normal	1,447	109
BX-112	SST	1.71	0.006	1.69	0.292	0.010	1.69	0.292	0.010	0.00	1180	70	1044	1316	normal	1,310	99
BY-101*	SST	3.60	0.292	3.60	0.292	0.010	2.44	0.024	0.010	0.00	1510	89	1335	1685	normal	1,838	139
BY-102	SST	2.76	0.292	2.76	0.292	0.010	1.73	0.024	0.010	0.00	1100	65	1000	1227	normal	1,571	119
BY-103	SST	4.01	0.292	4.01	0.292	0.010	3.14	0.024	0.010	0.00	1100	65	1000	1227	normal	1,660	125
BY-104	SST	3.93	0.292	3.93	0.292	0.010	2.25	0.024	0.010	0.00	1100	65	1000	1227	normal	1,714	129
BY-105	SST	4.63	0.292	4.63	0.292	0.010	2.79	0.024	0.010	0.00	1100	65	1000	1227	normal	1,801	136
BY-106	SST	4.46	0.292	4.46	0.292	0.010	1.90	0.024	0.010	0.00	1100	65	1000	1227	normal	1,673	126
BY-107	SST	2.70	0.292	2.70	0.292	0.010	1.79	0.024	0.010	0.00	1100	65	1000	1227	normal	1,687	127
BY-108	SST	2.24	0.292	2.24	0.292	0.010	1.70	0.024	0.010	0.00	1100	65	1000	1227	normal	1,485	112
BY-109	SST	2.84	0.292	2.84	0.292	0.010	2.73	0.024	0.010	0.00	1100	65	1000	1227	normal	1,706	129
BY-110	SST	3.57	0.292	3.57	0.292	0.010	2.52	0.024	0.010	0.00	1100	65	1000	1227	normal	1,565	118
BY-111	SST	3.91	0.292	3.91	0.292	0.010	1.81	0.024	0.010	0.00	1100	65	1000	1227	normal	1,673	126

Data Source		RPP-5926 R7 (Table B-2), RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5, RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5
Tank #	Tank Type	Total waste depth (m)	Total waste depth uncertainty (m)	Total non- convective waste depth (m)	Total non- convective waste depth uncertainty (m)	Total non- convective waste depth lower bound (m)	Wetted non- convective waste depth (m)	Wetted non- convective waste depth uncertainty (m)	Wetted non- convective waste depth lower bound (m)	Mean Crust depth (m)	Convective Waste Density Mean (kg/m3)	Convective Waste Density Std Dev (kg/m3)	Convective Waste Density Min (kg/m3)	Convective Waste Density Max (kg/m3)	Convective Waste Density Dist (kg/m3)	Non- Convective Waste Density Mean (kg/m3)	Non- Convective Waste Density Std Dev (kg/m3)
BY-112	SST	2.83	0.292	2.83	0.292	0.010	0.74	0.024	0.010	0.00	1100	65	1000	1227	normal	1,740	131
C-101	SST	1.00	0.292	1.00	0.292	0.010	1.00	0.292	0.000	0.00	1100	65	1000	1227	normal	1,780	134
C-102*	SST	3.11	0.292	3.11	0.292	0.010	3.11	0.292	0.000	0.00	1170	69	1035	1305	normal	1,681	127
C-103*	SST	0.21	0.006	0.21	0.292	0.010	0.21	0.292	0.010	0.00	1110	65	1000	1238	normal	1,610	122
C-104	SST	2.58	0.292	2.58	0.292	0.010	2.58	0.292	0.000	0.00	1100	65	1000	1227	normal	1,680	127
C-105	SST	1.41	0.292	1.41	0.292	0.010	1.41	0.292	0.000	0.00	1100	65	1000	1227	normal	1,550	117
C-106*	SST	0.22	0.006	0.21	0.292	0.010	0.21	0.292	0.010	0.00	1020	60	1000	1138	normal	1,560	118
C-107	SST	2.47	0.292	2.47	0.292	0.010	2.47	0.292	0.000	0.00	1100	65	1000	1227	normal	1,550	117
C-108*	SST	0.42	0.292	0.42	0.292	0.010	0.42	0.292	0.000	0.00	1170	69	1035	1305	normal	1,480	112
C-109	SST	0.77	0.292	0.77	0.292	0.010	0.77	0.292	0.000	0.00	1100	65	1000	1227	normal	1,548	117
C-110	SST	1.83	0.006	1.82	0.292	0.010	1.82	0.292	0.010	0.00	1100	65	1000	1227	normal	1,340	101
C-111	SST	0.72	0.292	0.72	0.292	0.010	0.72	0.292	0.000	0.00	1100	65	1000	1227	normal	1,552	117
C-112*	SST	1.15	0.292	1.15	0.292	0.010	1.15	0.292	0.000	0.00	1170	69	1035	1305	normal	1,575	119
C-201	SST	0.26	0.292	0.26	0.292	0.010	0.26	0.292	0.000	0.00	1100	65	1000	1227	normal	1,440	109
C-202	SST	0.10	0.006	0.10	0.292	0.010	0.10	0.292	0.000	0.00	1100	65	1000	1227	normal	1,440	109
C-203	SST	0.10	0.006	0.09	0.292	0.010	0.09	0.292	0.000	0.00	1000	59	1000	1116	normal	1,620	122
C-204*	SST	0.09	0.292	0.09	0.292	0.010	0.09	0.292	0.000	0.00	1000	59	1000	1116	normal	1,770	134
S-101	SST	3.44	0.292	3.44	0.292	0.010	3.20	0.024	0.010	0.00	1100	65	1000	1227	normal	1,652	125
S-102*	SST	0.75	0.292	0.75	0.292	0.010	0.00	0.292	0.010	0.00	1460	86	1291	1629	normal	1,797	136
S-103	SST	2.38	0.006	2.37	0.292	0.010	2.34	0.024	0.010	0.00	1450	86	1282	1618	normal	1,612	122
S-104*	SST	2.85	0.292	2.85	0.292	0.010	2.83	0.024	0.010	0.00	1370	81	1212	1528	normal	1,668	126
S-105	SST	3.94	0.292	3.94	0.292	0.010	1.40	0.024	0.010	0.00	1100	65	1000	1227	normal	1,657	125
S-106	SST	4.39	0.292	4.39	0.292	0.010	1.48	0.024	0.010	0.00	1100	65	1000	1227	normal	1,722	130
S-107	SST	3.50	0.292	3.50	0.292	0.010	3.10	0.024	0.010	0.00	1310	77	1159	1461	normal	1,775	134
S-108	SST	5.27	0.292	5.27	0.292	0.010	1.67	0.024	0.010	0.00	1100	65	1000	1227	normal	1,677	127
S-109	SST	5.11	0.292	5.11	0.292	0.010	1.85	0.024	0.010	0.00	1100	65	1000	1227	normal	1,657	125
S-110	SST	3.78	0.292	3.78	0.292	0.010	3.32	0.024	0.010	0.00	1100	65	1000	1227	normal	1,662	126
S-111	SST	3.99	0.292	3.99	0.292	0.010	2.25	0.024	0.010	0.00	1450	86	1282	1618	normal	1,544	117
S-112*	SST	0.21	0.292	0.21	0.292	0.010	0.00	0.292	0.010	0.00	1450	86	1282	1618	normal	1,711	129
SX-101	SST	4.07	0.292	4.07	0.292	0.010	3.05	0.024	0.010	0.00	1100	65	1000	1227	normal	1,679	127
SX-102	SST	3.36	0.292	3.36	0.292	0.010	3.36	0.292	0.000	0.00	1100	65	1000	1227	normal	1,697	128
SX-103	SST	4.91	0.292	4.91	0.292	0.010	2.46	0.024	0.010	0.00	1470	87	1300	1640	normal	1,729	131
SX-104*	SST	4.33	0.292	4.33	0.292	0.010	2.40	0.024	0.010	0.00	1470	87	1300	1640	normal	1,695	128
SX-105	SST	3.68	0.292	3.68	0.292	0.010	2.46	0.024	0.010	0.00	1100	65	1000	1227	normal	1,630	123
SX-106	SST	3.87	0.292	3.87	0.292	0.010	2.02	0.024	0.010	0.00	1100	65	1000	1227	normal	1,578	119
SX-107	SST	1.08	0.292	1.08	0.292	0.010	1.08	0.292	0.000	0.00	1100	65	1000	1227	normal	1,770	134
SX-108	SST	0.89	0.292	0.89	0.292	0.010	0.89	0.292	0.000	0.00	1100	65	1000	1227	normal	1,770	134

Data Source		RPP-5926 R7 (Table B-2), RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5, RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5
Tank #	Tank Type	Total waste depth (m)	Total waste depth uncertainty (m)	Total non- convective waste depth (m)	Total non- convective waste depth uncertainty (m)	Total non- convective waste depth lower bound (m)	Wetted non- convective waste depth (m)	Wetted non- convective waste depth uncertainty (m)	Wetted non- convective waste depth lower bound (m)	Mean Crust depth (m)	Convective Waste Density Mean (kg/m3)	Convective Waste Density Std Dev (kg/m3)	Convective Waste Density Min (kg/m3)	Convective Waste Density Max (kg/m3)	Convective Waste Density Dist (kg/m3)	Non- Convective Waste Density Mean (kg/m3)	Non- Convective Waste Density Std Dev (kg/m3)
SX-109	SST	2.44	0.292	2.44	0.292	0.010	2.44	0.292	0.000	0.00	1100	65	1000	1227	normal	1,734	131
SX-110	SST	0.72	0.292	0.72	0.292	0.010	0.72	0.292	0.000	0.00	1100	65	1000	1227	normal	1,763	133
SX-111	SST	1.27	0.292	1.27	0.292	0.010	0.34	0.024	0.010	0.00	1100	65	1000	1227	normal	1,762	133
SX-112	SST	0.90	0.292	0.90	0.292	0.010	0.51	0.024	0.000	0.00	1100	65	1000	1227	normal	1,770	134
SX-113	SST	0.38	0.292	0.38	0.292	0.010	0.38	0.292	0.000	0.00	1100	65	1000	1227	normal	1,750	132
SX-114	SST	1.64	0.292	1.64	0.292	0.010	1.64	0.292	0.000	0.00	1100	65	1000	1227	normal	1,751	132
SX-115	SST	0.17	0.292	0.17	0.292	0.010	0.17	0.292	0.000	0.00	1100	65	1000	1227	normal	1,770	134
SY-101*	DST	10.19	0.006	2.31	0.30	0.01	2.31	0.30	0.01	0.00	1130	92	1000	1311	normal	1520	99
SY-102*	DST	4.36	0.006	1.93	0.25	0.01	1.93	0.25	0.01	0.00	1130	92	1000	1311	normal	1544	100
SY-103*	DST	6.81	0.065	3.68	0.40	0.01	3.68	0.40	0.01	0.58	1470	120	1235	1705	normal	1610	105
T-101	SST	1.11	0.292	1.11	0.292	0.010	1.09	0.024	0.000	0.00	1100	65	1000	1227	normal	1,544	117
T-102	SST	0.48	0.006	0.37	0.292	0.010	0.37	0.292	0.010	0.00	1140	67	1008	1272	normal	1,797	136
T-103	SST	0.44	0.006	0.40	0.292	0.010	0.40	0.292	0.010	0.00	1190	70	1052	1328	normal	1,714	129
T-104	SST	3.11	0.292	3.11	0.292	0.010	2.73	0.024	0.010	0.00	1100	65	1000	1227	normal	1,290	97
T-105	SST	1.09	0.292	1.09	0.292	0.010	1.09	0.292	0.000	0.00	1100	65	1000	1227	normal	1,460	110
T-106	SST	0.39	0.292	0.39	0.292	0.010	0.39	0.292	0.000	0.00	1100	65	1000	1227	normal	1,587	120
T-107	SST	1.79	0.292	1.79	0.292	0.010	1.79	0.292	0.000	0.00	1100	65	1000	1227	normal	1,560	118
T-108	SST	0.34	0.292	0.34	0.292	0.010	0.34	0.292	0.000	0.00	1100	65	1000	1227	normal	1,547	117
T-109	SST	0.76	0.292	0.76	0.292	0.010	0.57	0.024	0.010	0.00	1100	65	1000	1227	normal	1,646	124
T-110	SST	3.61	0.006	3.60	0.292	0.010	3.60	0.292	0.010	0.00	1050	62	1000	1171	normal	1,250	94
T-111	SST	4.32	0.292	4.32	0.292	0.010	4.24	0.024	0.010	0.00	1100	65	1000	1227	normal	1,240	94
T-112	SST	0.80	0.006	0.74	0.292	0.010	0.74	0.292	0.010	0.00	1100	65	1000	1227	normal	1,280	97
T-201	SST	4.16	0.006	3.88	0.292	0.010	3.88	0.292	0.010	0.00	1060	63	1000	1183	normal	1,310	99
T-202	SST	2.85	0.292	2.85	0.292	0.010	2.85	0.292	0.000	0.00	1100	65	1000	1227	normal	1,180	89
T-203	SST	4.88	0.292	4.88	0.292	0.010	4.88	0.292	0.000	0.00	1100	65	1000	1227	normal	1,220	92
T-204	SST	4.88	0.292	4.88	0.292	0.010	4.88	0.292	0.000	0.00	1100	65	1000	1227	normal	1,180	89
TX-101	SST	1.03	0.292	1.03	0.292	0.010	1.03	0.292	0.000	0.00	1100	65	1000	1227	normal	1,740	131
TX-102	SST	2.19	0.292	2.19	0.292	0.010	1.52	0.024	0.010	0.00	1100	65	1000	1227	normal	1,614	122
TX-103	SST	1.53	0.292	1.53	0.292	0.010	1.17	0.024	0.000	0.00	1100	65	1000	1227	normal	1,611	122
TX-104	SST	0.83	0.006	0.81	0.292	0.010	0.81	0.292	0.010	0.00	1440	85	1273	1607	normal	1,737	131
TX-105	SST	5.51	0.292	5.51	0.292	0.010	1.44	0.024	0.010	0.00	1100	65	1000	1227	normal	1,634	123
TX-106	SST	3.41	0.292	3.41	0.292	0.010	2.42	0.024	0.010	0.00	1100	65	1000	1227	normal	1,620	122
TX-107	SST	0.46	0.292	0.46	0.292	0.010	0.46	0.292	0.000	0.00	1100	65	1000	1227	normal	1,782	135
TX-108	SST	1.36	0.292	1.36	0.292	0.010	1.36	0.292	0.000	0.00	1100	65	1000	1227	normal	1,622	122
TX-109	SST	3.54	0.292	3.54	0.292	0.010	3.21	0.024	0.010	0.00	1100	65	1000	1227	normal	1,430	108
TX-110	SST	4.51	0.292	4.51	0.292	0.010	1.48	0.024	0.010	0.00	1100	65	1000	1227	normal	1,618	122
TX-111	SST	3.56	0.292	3.56	0.292	0.010	1.83	0.024	0.010	0.00	1100	65	1000	1227	normal	1,612	122

Data Source		RPP-5926 R7 (Table B-2), RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5, RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7, Appendix C	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7 (Table B-1), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5
Tank #	Tank Type	Total waste depth (m)	Total waste depth uncertainty (m)	Total non- convective waste depth (m)	Total non- convective waste depth uncertainty (m)	Total non- convective waste depth lower bound (m)	Wetted non- convective waste depth (m)	Wetted non- convective waste depth uncertainty (m)	Wetted non- convective waste depth lower bound (m)	Mean Crust depth (m)	Convective Waste Density Mean (kg/m3)	Convective Waste Density Std Dev (kg/m3)	Convective Waste Density Min (kg/m3)	Convective Waste Density Max (kg/m3)	Convective Waste Density Dist (kg/m3)	Non- Convective Waste Density Mean (kg/m3)	Non- Convective Waste Density Std Dev (kg/m3)
TX-112	SST	6.04	0.292	6.04	0.292	0.010	3.42	0.024	0.010	0.00	1100	65	1000	1227	normal	1,633	123
TX-113	SST	6.08	0.292	6.08	0.292	0.010	1.90	0.024	0.010	0.00	1100	65	1000	1227	normal	1,608	121
TX-114	SST	5.10	0.292	5.10	0.292	0.010	2.00	0.024	0.010	0.00	1100	65	1000	1227	normal	1,634	123
TX-115	SST	5.30	0.292	5.30	0.292	0.010	2.56	0.024	0.010	0.00	1100	65	1000	1227	normal	1,628	123
TX-116	SST	5.71	0.292	5.71	0.292	0.010	1.39	0.024	0.000	0.00	1100	65	1000	1227	normal	1,658	125
TX-117	SST	4.62	0.292	4.62	0.292	0.010	1.13	0.024	0.010	0.00	1100	65	1000	1227	normal	1,581	119
TX-118	SST	2.47	0.292	2.47	0.292	0.010	2.08	0.024	0.010	0.00	1100	65	1000	1227	normal	1,692	128
TY-101	SST	1.28	0.292	1.28	0.292	0.010	1.28	0.292	0.000	0.00	1100	65	1000	1227	normal	1,627	123
TY-102	SST	0.83	0.292	0.83	0.292	0.010	0.83	0.292	0.000	0.00	1100	65	1000	1227	normal	1,756	133
TY-103	SST	1.62	0.292	1.62	0.292	0.010	1.60	0.024	0.010	0.00	1100	65	1000	1227	normal	1,681	127
TY-104	SST	0.60	0.006	0.59	0.292	0.010	0.59	0.292	0.010	0.00	1180	70	1044	1316	normal	1,650	125
TY-105	SST	2.32	0.292	2.32	0.292	0.010	1.65	0.024	0.010	0.00	1100	65	1000	1227	normal	1,530	116
TY-106	SST	0.34	0.292	0.34	0.292	0.010	0.34	0.292	0.000	0.00	1100	65	1000	1227	normal	1,400	106
U-101	SST	0.40	0.292	0.40	0.292	0.010	0.40	0.292	0.000	0.00	1100	65	1000	1227	normal	1,770	134
U-102	SST	3.21	0.292	3.21	0.292	0.010	2.01	0.024	0.010	0.00	1480	87	1309	1651	normal	1,673	126
U-103	SST	4.04	0.292	4.04	0.292	0.010	1.53	0.024	0.010	0.00	1440	85	1273	1607	normal	1,702	128
U-104	SST	1.32	0.292	1.32	0.292	0.010	1.32	0.292	0.000	0.00	1100	65	1000	1227	normal	1,427	108
U-105	SST	3.45	0.292	3.45	0.292	0.010	2.58	0.024	0.010	0.00	1100	65	1000	1227	normal	1,670	126
U-106	SST	1.76	0.006	1.75	0.292	0.010	1.75	0.292	0.010	0.00	1340	79	1185	1495	normal	1,552	117
U-107	SST	2.91	0.292	2.91	0.292	0.010	1.92	0.024	0.010	0.00	1390	82	1229	1551	normal	1,738	131
U-108	SST	4.23	0.292	4.23	0.292	0.010	2.96	0.024	0.010	0.00	1400	83	1238	1562	normal	1,681	127
U-109	SST	3.89	0.292	3.89	0.292	0.010	2.00	0.024	0.010	0.00	1100	65	1000	1227	normal	1,653	125
U-110	SST	1.81	0.292	1.81	0.292	0.010	0.81	0.024	0.010	0.00	1100	65	1000	1227	normal	1,715	130
U-111	SST	2.24	0.292	2.24	0.292	0.010	1.84	0.024	0.010	0.00	1100	65	1000	1227	normal	1,609	121
U-112	SST	0.61	0.292	0.61	0.292	0.010	0.61	0.292	0.000	0.00	1100	65	1000	1227	normal	1,743	132
U-201	SST	0.73	0.006	0.58	0.292	0.010	0.58	0.292	0.010	0.00	1260	74	1114	1406	normal	1,630	123
U-202	SST	0.69	0.006	0.54	0.292	0.010	0.54	0.292	0.010	0.00	1280	76	1132	1428	normal	1,510	114
U-203	SST	0.65	0.006	0.50	0.292	0.010	0.50	0.292	0.010	0.00	1280	76	1132	1428	normal	1,590	120
U-204	SST	0.58	0.006	0.42	0.292	0.010	0.42	0.292	0.010	0.00	1110	65	1000	1238	normal	1,470	111

Data Source		Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7, RPP-10006 R5	RPP-5926 R7, RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5, OSD-T-151- 00007, R1	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data
Tank #	Tank Type	Non- Convective Waste Density Min (kg/m3)	Non- Convective Waste Density Max (kg/m3)	Non- Convective Waste Density Dist (kg/m3)	Non- Convective Waste Average Temperatur e (K)	Tank Vapor Space Average Temperatur e (K)	Tank type group	Total tank volume (m3)	OSD Maximum Operating Limit (m)	Dish type	Dish height (m)	Dish volume (kL)	Dish Radius (m)	Knuckle height (m)	Knuckle volume (M3)	Knuckle Radius (m)	Body height (m)
A-101*	SST	1,449	1,952	normal	317	301	a	4,988	9.27	flat	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	9.855
A-102	SST	1,422	1,916	normal	307	306	a	4,988	9.27	flat	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	9.855
A-103	SST	1,491	2,009	normal	312	302	a	4,988	9.27	flat	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	9.855
A-104	SST	1,491	2,009	normal	347	307	a	4,988	9.27	flat	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	9.855
A-105	SST	1,312	1,768	normal	347	307	a	4,988	9.27	flat	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	9.855
A-106	SST	1,448	1,952	normal	327	312	a	4,988	9.27	flat	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	9.855
AN-101*	DST	1352	1747	normal	296	296	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AN-102*	DST	1335	1725	normal	303	303	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AN-103*	DST	1501	1939	normal	309	302	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AN-104*	DST	1387	1793	normal	309	301	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AN-105*	DST	1370	1770	normal	305	297	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AN-106*	DST	1295	1673	normal	309	308	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AN-107*	DST	1291	1669	normal	305	301	an	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-101*	DST	1527	1973	normal	294	295	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-102*	DST	1527	1973	normal	297	304	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-103*	DST	1466	1894	normal	297	296	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-104*	DST	1405	1815	normal	298	295	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-105*	DST	1405	1815	normal	293	293	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-106*	DST	1405	1815	normal	297	293	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-107*	DST	1405	1815	normal	293	287	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AP-108*	DST	1353	1747	normal	296	295	ap	5,324	11.53	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AW-101*	DST	1387	1793	normal	308	297	aw	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AW-102*	DST	1396	1804	normal	301	298	aw	5,324	10.39	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AW-103*	DST	1299	1678	normal	293	295	aw	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AW-104*	DST	1295	1674	normal	301	298	aw	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AW-105*	DST	1162	1502	normal	290	293	aw	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AW-106*	DST	1545	1995	normal	308	294	aw	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AX-101	SST	1,450	1,954	normal	308	302	ax	5,046	9.27	flat	0.0008	0.0000	0.0000	0.1524	62.2477	0.1524	9.754
AX-102	SST	1,344	1,811	normal	297	298	ax	5,046	9.27	flat	0.0008	0.0000	0.0000	0.1524	62.2477	0.1524	9.754
AX-103	SST	1,346	1,814	normal	311	305	ax	5,046	9.27	flat	0.0008	0.0000	0.0000	0.1524	62.2477	0.1524	9.754
AX-104*	SST	1,534	2,066	normal	305	303	ax	5,046	9.27	flat	0.0008	0.0000	0.0000	0.1524	62.2477	0.1524	9.754
AY-101*	DST	1469	1898	normal	307	298	ay	5,325	9.42	flat	0.0127	4.16	0.00	0.30	123.44	0.30	10.42
AY-102*	DST	1389	1795	normal	327	313	ay	5,325	9.42	flat	0.0127	4.16	0.00	0.30	123.44	0.30	10.42
AZ-101*	DST	1405	1815	normal	347	319	az	5,324	9.42	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
AZ-102*	DST	1230	1590	normal	355	336	az	5,324	9.42	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
B-101	SST	1,269	1,709	normal	313	307	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-102	SST	1,373	1,850	normal	291	294	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269

Data Source		Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7, RPP-10006 R5	RPP-5926 R7, RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5, OSD-T-151- 00007, R1	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data
Tank #	Tank Type	Non- Convective Waste Density Min (kg/m3)	Non- Convective Waste Density Max (kg/m3)	Non- Convective Waste Density Dist (kg/m3)	Non- Convective Waste Average Temperatur e (K)	Tank Vapor Space Average Temperatur e (K)	Tank type group	Total tank volume (m3)	OSD Maximum Operating Limit (m)	Dish type	Dish height (m)	Dish volume (kL)	Dish Radius (m)	Knuckle height (m)	Knuckle volume (M3)	Knuckle Radius (m)	Body height (m)
B-103	SST	1,374	1,851	normal	290	293	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-104	SST	1,180	1,590	normal	294	295	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-105	SST	1,408	1,898	normal	293	292	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-106	SST	1,177	1,586	normal	296	293	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-107	SST	1,385	1,867	normal	289	294	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-108	SST	1,428	1,924	normal	294	293	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-109	SST	1,520	2,047	normal	293	294	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-110	SST	1,159	1,561	normal	295	298	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-111	SST	1,082	1,458	normal	299	299	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-112	SST	1,491	2,009	normal	294	294	b	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
B-201	SST	1,074	1,446	normal	291	292	b2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
B-202*	SST	1,039	1,401	normal	291	293	b2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
B-203	SST	1,014	1,366	normal	292	285	b2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
B-204	SST	1,014	1,366	normal	292	293	b2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
BX-101	SST	1,431	1,929	normal	296	296	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-102*	SST	1,527	1,286	normal	295	295	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-103*	SST	1,415	1,907	normal	294	296	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-104	SST	1,431	1,929	normal	303	298	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-105	SST	1,443	1,945	normal	293	294	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-106*	SST	1,378	1,857	normal	294	300	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-107	SST	1,227	1,653	normal	293	294	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-108	SST	1,242	1,673	normal	293	293	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-109	SST	1,295	1,745	normal	294	295	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-110	SST	1,420	1,913	normal	293	294	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-111	SST	1,233	1,661	normal	293	292	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BX-112	SST	1,116	1,504	normal	293	293	bx	3,215	4.80	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	4.276
BY-101*	SST	1,566	2,110	normal	297	297	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-102	SST	1,338	1,803	normal	295	295	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-103	SST	1,415	1,906	normal	296	293	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-104	SST	1,460	1,967	normal	312	299	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-105	SST	1,534	2,067	normal	307	300	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-106	SST	1,426	1,921	normal	306	306	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-107	SST	1,438	1,937	normal	304	298	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-108	SST	1,265	1,704	normal	307	300	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-109	SST	1,453	1,958	normal	292	290	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-110	SST	1,334	1,797	normal	309	299	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
BY-111	SST	1,426	1,921	normal	299	296	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079

Data Source		Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7, RPP-10006 R5	RPP-5926 R7, RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5, OSD-T-151- 00007, R1	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data
Tank #	Tank Type	Non- Convective Waste Density Min (kg/m3)	Non- Convective Waste Density Max (kg/m3)	Non- Convective Waste Density Dist (kg/m3)	Non- Convective Waste Average Temperatur e (K)	Tank Vapor Space Average Temperatur e (K)	Tank type group	Total tank volume (m3)	OSD Maximum Operating Limit (m)	Dish type	Dish height (m)	Dish volume (kL)	Dish Radius (m)	Knuckle height (m)	Knuckle volume (M3)	Knuckle Radius (m)	Body height (m)
BY-112	SST	1,482	1,997	normal	303	297	by	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
C-101	SST	1,517	2,043	normal	305	306	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-102*	SST	1,432	1,930	normal	301	299	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-103*	SST	1,372	1,848	normal	316	298	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-104	SST	1,431	1,929	normal	309	306	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-105	SST	1,321	1,779	normal	321	316	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-106*	SST	1,329	1,791	normal	303	299	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-107	SST	1,321	1,779	normal	316	314	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-108*	SST	1,261	1,699	normal	298	299	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-109	SST	1,319	1,777	normal	299	299	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-110	SST	1,142	1,538	normal	294	296	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-111	SST	1,322	1,781	normal	298	298	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-112*	SST	1,342	1,808	normal	300	300	c	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
C-201	SST	1,227	1,653	normal	289	293	c2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
C-202	SST	1,227	1,653	normal	289	292	c2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
C-203	SST	1,380	1,860	normal	288	292	c2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
C-204*	SST	1,508	2,032	normal	291	289	c2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
S-101	SST	1,407	1,896	normal	313	305	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-102*	SST	1,531	2,063	normal	302	298	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-103	SST	1,374	1,851	normal	300	297	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-104*	SST	1,421	1,914	normal	312	304	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-105	SST	1,412	1,902	normal	297	296	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-106	SST	1,467	1,977	normal	297	297	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-107	SST	1,513	2,038	normal	307	299	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-108	SST	1,429	1,926	normal	300	296	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-109	SST	1,412	1,903	normal	300	297	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-110	SST	1,416	1,908	normal	314	302	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-111	SST	1,315	1,772	normal	301	294	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
S-112*	SST	1,458	1,964	normal	302	294	s	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
SX-101	SST	1,431	1,928	normal	324	312	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-102	SST	1,446	1,948	normal	326	309	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-103	SST	1,473	1,985	normal	333	305	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-104*	SST	1,444	1,946	normal	322	333	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-105	SST	1,389	1,872	normal	333	307	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-106	SST	1,345	1,812	normal	307	299	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-107	SST	1,508	2,032	normal	343	326	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-108	SST	1,508	2,032	normal	350	332	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474

Data Source		Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7, RPP-10006 R5	RPP-5926 R7, RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5, OSD-T-151- 00007, R1	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data
Tank #	Tank Type	Non- Convective Waste Density Min (kg/m3)	Non- Convective Waste Density Max (kg/m3)	Non- Convective Waste Density Dist (kg/m3)	Non- Convective Waste Average Temperatur e (K)	Tank Vapor Space Average Temperatur e (K)	Tank type group	Total tank volume (m3)	OSD Maximum Operating Limit (m)	Dish type	Dish height (m)	Dish volume (kL)	Dish Radius (m)	Knuckle height (m)	Knuckle volume (M3)	Knuckle Radius (m)	Body height (m)
SX-109	SST	1,477	1,990	normal	326	321	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-110	SST	1,502	2,024	normal	342	320	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-111	SST	1,502	2,023	normal	347	330	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-112	SST	1,508	2,032	normal	333	323	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-113	SST	1,491	2,009	normal	301	301	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-114	SST	1,492	2,010	normal	346	325	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SX-115	SST	1,508	2,032	normal	299	298	sx	4,903	9.35	dished	0.3778	77.8029	173.6110	0.0000	0.0000	0.0000	9.474
SY-101*	DST	1326	1714	normal	298	292	sy	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
SY-102*	DST	1347	1741	normal	297	295	sy	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
SY-103*	DST	1405	1815	normal	308	296	sy	5,324	10.72	flat	0.0095	3.12	0.00	0.30	123.44	0.30	10.42
T-101	SST	1,316	1,773	normal	295	294	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-102	SST	1,531	2,063	normal	291	291	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-103	SST	1,460	1,968	normal	292	293	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-104	SST	1,099	1,481	normal	293	295	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-105	SST	1,244	1,676	normal	290	289	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-106	SST	1,352	1,822	normal	293	294	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-107	SST	1,329	1,791	normal	292	295	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-108	SST	1,318	1,776	normal	289	294	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-109	SST	1,402	1,889	normal	292	293	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-110	SST	1,065	1,435	normal	291	293	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-111	SST	1,057	1,423	normal	292	295	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-112	SST	1,091	1,469	normal	292	294	t	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
T-201	SST	1,116	1,504	normal	290	293	t2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
T-202	SST	1,005	1,355	normal	290	293	t2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
T-203	SST	1,039	1,401	normal	290	293	t2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
T-204	SST	1,005	1,355	normal	290	294	t2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
TX-101	SST	1,482	1,997	normal	298	297	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-102	SST	1,375	1,853	normal	300	298	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-103	SST	1,372	1,849	normal	295	295	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-104	SST	1,480	1,994	normal	294	294	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-105	SST	1,392	1,876	normal	307	297	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-106	SST	1,380	1,860	normal	299	299	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-107	SST	1,518	2,046	normal	295	295	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-108	SST	1,382	1,862	normal	294	294	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-109	SST	1,218	1,642	normal	308	312	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-110	SST	1,379	1,858	normal	301	295	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-111	SST	1,373	1,850	normal	298	296	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079

Data Source		Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	Calculated value (see RPP-10006, Appendix B), RPP-10006 R5	RPP-10006, Appendix B	RPP-5926 R7, RPP-10006 R5	RPP-5926 R7, RPP-10006 R5	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5, OSD-T-151- 00007, R1	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data
Tank #	Tank Type	Non- Convective Waste Density Min (kg/m3)	Non- Convective Waste Density Max (kg/m3)	Non- Convective Waste Density Dist (kg/m3)	Non- Convective Waste Average Temperatur e (K)	Tank Vapor Space Average Temperatur e (K)	Tank type group	Total tank volume (m3)	OSD Maximum Operating Limit (m)	Dish type	Dish height (m)	Dish volume (kL)	Dish Radius (m)	Knuckle height (m)	Knuckle volume (M3)	Knuckle Radius (m)	Body height (m)
TX-112	SST	1,391	1,874	normal	295	296	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-113	SST	1,370	1,846	normal	294	291	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-114	SST	1,392	1,876	normal	294	291	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-115	SST	1,387	1,869	normal	295	294	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-116	SST	1,412	1,903	normal	294	293	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-117	SST	1,347	1,816	normal	294	293	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TX-118	SST	1,441	1,942	normal	297	294	tx	3,967	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.079
TY-101	SST	1,386	1,868	normal	292	293	ty	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
TY-102	SST	1,496	2,015	normal	289	293	ty	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
TY-103	SST	1,432	1,929	normal	294	293	ty	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
TY-104	SST	1,406	1,894	normal	293	293	ty	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
TY-105	SST	1,304	1,756	normal	298	295	ty	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
TY-106	SST	1,193	1,607	normal	289	293	ty	3,975	7.14	dished	0.3048	50.6413	173.6110	1.2171	477.3316	1.2192	6.098
U-101	SST	1,508	2,032	normal	294	295	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-102	SST	1,425	1,920	normal	299	301	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-103	SST	1,450	1,954	normal	301	299	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-104	SST	1,216	1,638	normal	301	298	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-105	SST	1,423	1,918	normal	301	296	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-106	SST	1,323	1,782	normal	300	295	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-107	SST	1,481	1,995	normal	297	297	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-108	SST	1,432	1,929	normal	303	300	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-109	SST	1,408	1,897	normal	303	298	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-110	SST	1,462	1,969	normal	298	298	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-111	SST	1,371	1,847	normal	298	298	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-112	SST	1,485	2,000	normal	294	294	u	3,215	4.80	dished	0.3048	50.6778	173.7360	1.2171	477.6507	1.2192	4.269
U-201	SST	1,389	1,871	normal	290	290	u2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
U-202	SST	1,287	1,733	normal	292	292	u2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
U-203	SST	1,355	1,825	normal	292	292	u2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866
U-204	SST	1,252	1,688	normal	291	292	u2	225	7.24	dished	0.1524	1.2214	16.7894	0.9065	23.3622	0.9144	6.866

Data Source		RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type
Tank #	Tank Type	Body volume (M3)	Body Operating Capacity (m3/m)	Body Radius (m)	Dome Arc height (m)	Dome Arc volume (M3)	Dome Arc Radius (m)	Tank capacity (kL/m)	Void Fraction or Maximum Wetted Solids Void Fraction Mean (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Uncertainty (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Minimum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Maximum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Dist Type (Dimension- less)	non- convective waste yield stress mean (Pa)	non- convective waste yield stress std dev (Pa)	non- convective waste yield stress min (Pa)	non- convective waste yield stress max (Pa)
A-101*	SST	4,053.92	411.35	11.443	0.0000	0.000	0.0000	411.35	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
A-102	SST	4,053.92	411.35	11.443	0.0000	0.000	0.0000	411.35	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
A-103	SST	4,053.92	411.35	11.443	0.0000	0.000	0.0000	411.35	0.400	0.2	0.01	40	normal	631.25	260.88	109.49	1674.77
A-104	SST	4,053.92	411.35	11.443	0.0000	0.000	0.0000	411.35	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
A-105	SST	4,053.92	411.35	11.443	0.0000	0.000	0.0000	411.35	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
A-106	SST	4,053.92	411.35	11.443	0.0000	0.000	0.0000	411.35	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
AN-101*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AN-102*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AN-103*	DST	4263	409	11.42	0.97	379	1.22	409.04	10.70	5.35	0.01	15.11	normal	144.00	13.87	88.52	199.48
AN-104*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.20	3.10	0.01	15.11	normal	144.00	13.87	88.52	199.48
AN-105*	DST	4263	409	11.42	0.97	379	1.22	409.04	4.20	2.10	0.01	15.11	normal	144.00	13.87	88.52	199.48
AN-106*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AN-107*	DST	4263	409	11.42	0.97	379	1.22	409.04	1.10	0.55	0.01	15.11	normal	144.00	13.87	88.52	199.48
AP-101*	DST	4263	409	11.42	0.97	379	1.22	409.07	0.02	0.00	0.01	0.02	normal	144.00	13.87	88.52	199.48
AP-102*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AP-103*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AP-104*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AP-105*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AP-106*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AP-107*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AP-108*	DST	4263	409	11.42	0.97	379	1.22	409.07	6.37	2.73	0.01	15.11	normal	144.00	13.87	88.52	199.48
AW-101*	DST	4263	409	11.42	0.97	379	1.22	409.04	4.70	2.35	0.01	15.11	normal	144.00	13.87	88.52	199.48
AW-102*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AW-103*	DST	4263	409	11.42	0.97	379	1.22	409.04	0.90	0.45	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AW-104*	DST	4263	409	11.42	0.97	379	1.22	409.04	5.80	2.90	0.00	15.11	normal	144.00	13.87	88.52	199.48
AW-105*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AW-106*	DST	4263	409	11.42	0.97	379	1.22	409.04	3.20	1.60	0.01	15.11	normal	144.00	13.87	88.52	199.48
AX-101	SST	4,005.45	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
AX-102	SST	4,005.45	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
AX-103	SST	4,005.45	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
AX-104*	SST	4,005.45	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
AY-101*	DST	4263	409	11.43	0.97	378	1.22	409.07	4.20	2.10	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AY-102*	DST	4263	409	11.43	0.97	378	1.22	409.07	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AZ-101*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
AZ-102*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.37	2.73	0.01	15.11	normal	829.55	218.64	173.63	1704.11
B-101	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
B-102	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.700	1.35	0.01	40	normal	631.25	260.88	109.49	1674.77

Data Source		RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type
Tank #	Tank Type	Body volume (M3)	Body Operating Capacity (m3/m)	Body Radius (m)	Dome Arc height (m)	Dome Arc volume (M3)	Dome Arc Radius (m)	Tank capacity (kL/m)	Void Fraction or Maximum Wetted Solids Void Fraction Mean (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Uncertainty (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Minimum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Maximum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Dist Type (Dimension- less)	non- convective waste yield stress mean (Pa)	non- convective waste yield stress std dev (Pa)	non- convective waste yield stress min (Pa)	non- convective waste yield stress max (Pa)
B-103	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
B-104	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-105	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
B-106	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-107	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
B-108	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
B-109	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
B-110	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-111	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-112	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.500	1.25	0.01	40	normal	631.25	260.88	109.49	1674.77
B-201	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-202*	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-203	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
B-204	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
BX-101	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.000	1	0.001	26.5	normal	1143.27	272.08	327.03	2231.59
BX-102*	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
BX-103*	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	1.200	0.6	0.001	26.5	normal	1143.27	272.08	327.03	2231.59
BX-104	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	7.500	3.75	0.001	26.5	normal	1143.27	272.08	327.03	2231.59
BX-105	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	1.600	0.8	0.01	40	normal	631.25	260.88	109.49	1674.77
BX-106*	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BX-107	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.500	1.25	0.001	26.5	normal	1143.27	272.08	327.03	2231.59
BX-108	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
BX-109	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
BX-110	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	4.000	2	0.01	40	normal	631.25	260.88	109.49	1674.77
BX-111	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	0.500	0.25	0.01	40	normal	631.25	260.88	109.49	1674.77
BX-112	SST	1,754.89	410.44	11.430	0.0000	0.000	0.0000	410.44	0.500	0.25	0.001	26.5	normal	1143.27	272.08	327.03	2231.59
BY-101*	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-102	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-103	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-104	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-105	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-106	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-107	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-108	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-109	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-110	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
BY-111	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77

Data Source		RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type
Tank #	Tank Type	Body volume (M3)	Body Operating Capacity (m3/m)	Body Radius (m)	Dome Arc height (m)	Dome Arc volume (M3)	Dome Arc Radius (m)	Tank capacity (kL/m)	Void Fraction or Maximum Wetted Solids Void Fraction Mean (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Uncertainty (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Minimum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Maximum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Dist Type (Dimension- less)	non- convective waste yield stress mean (Pa)	non- convective waste yield stress std dev (Pa)	non- convective waste yield stress min (Pa)	non- convective waste yield stress max (Pa)
BY-112	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
C-101	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-102*	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-103*	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	0.600	0.3	0.001	26.5	normal	1143.27	272.08	327.03	2231.59
C-104	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-105	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-106*	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-107	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-108*	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-109	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-110	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-111	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-112*	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-201	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-202	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-203	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
C-204*	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
S-101	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	4.300	2.15	0.01	40	normal	631.25	260.88	109.49	1674.77
S-102*	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
S-103	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	14.700	7.35	0.01	40	normal	631.25	260.88	109.49	1674.77
S-104*	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
S-105	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
S-106	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.200	4.1	0.01	40	normal	631.25	260.88	109.49	1674.77
S-107	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.400	1.2	0.01	26.5	normal	1143.27	272.08	327.03	2231.59
S-108	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
S-109	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
S-110	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
S-111	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	11.900	5.95	0.01	40	normal	631.25	260.88	109.49	1674.77
S-112*	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-101	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-102	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-103	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-104*	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-105	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-106	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	14.000	7	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-107	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SX-108	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59

Data Source		RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type
Tank #	Tank Type	Body volume (M3)	Body Operating Capacity (m3/m)	Body Radius (m)	Dome Arc height (m)	Dome Arc volume (M3)	Dome Arc Radius (m)	Tank capacity (kL/m)	Void Fraction or Maximum Wetted Solids Void Fraction Mean (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Uncertainty (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Minimum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Maximum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Dist Type (Dimension- less)	non- convective waste yield stress mean (Pa)	non- convective waste yield stress std dev (Pa)	non- convective waste yield stress min (Pa)	non- convective waste yield stress max (Pa)
SX-109	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
SX-110	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SX-111	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SX-112	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SX-113	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SX-114	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SX-115	SST	3,890.71	410.66	11.433	0.0000	0.000	0.0000	410.66	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
SY-101*	DST	4263	409	11.42	0.97	379	1.22	409.04	8.50	4.25	0.00	15.11	normal	144.00	13.87	88.52	199.48
SY-102*	DST	4263	409	11.42	0.97	379	1.22	409.04	0.90	0.45	0.01	15.11	normal	829.55	218.64	173.63	1704.11
SY-103*	DST	4263	409	11.42	0.97	379	1.22	409.04	6.00	3.00	0.00	15.11	normal	144.00	13.87	88.52	199.48
T-101	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	0.700	0.35	0.01	40	normal	631.25	260.88	109.49	1674.77
T-102	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-103	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-104	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-105	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-106	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-107	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-108	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
T-109	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
T-110	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-111	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-112	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-201	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-202	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-203	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
T-204	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
TX-101	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	0.900	0.45	0.01	26.5	normal	1143.27	272.08	327.03	2231.59
TX-102	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-103	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-104	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	1.200	0.6	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-105	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-106	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-107	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	2.100	1.05	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-108	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-109	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
TX-110	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-111	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77

Data Source		RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 Data	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type	RPP-10006 R5 based on waste type
Tank #	Tank Type	Body volume (M3)	Body Operating Capacity (m3/m)	Body Radius (m)	Dome Arc height (m)	Dome Arc volume (M3)	Dome Arc Radius (m)	Tank capacity (kL/m)	Void Fraction or Maximum Wetted Solids Void Fraction Mean (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Uncertainty (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Minimum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Maximum (Dimension- less)	Void Fraction or Maximum Wetted Solids Void Fraction Dist Type (Dimension- less)	non- convective waste yield stress mean (Pa)	non- convective waste yield stress std dev (Pa)	non- convective waste yield stress min (Pa)	non- convective waste yield stress max (Pa)
TX-112	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-113	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-114	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-115	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-116	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-117	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TX-118	SST	2,495.07	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TY-101	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TY-102	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TY-103	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
TY-104	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	1.700	0.85	0.01	26.5	normal	1143.27	272.08	327.03	2231.59
TY-105	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
TY-106	SST	2,502.89	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-101	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-102	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
U-103	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.000	4	0.01	40	normal	631.25	260.88	109.49	1674.77
U-104	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-105	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	7.300	3.65	0.01	40	normal	631.25	260.88	109.49	1674.77
U-106	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	1.500	0.75	0.01	40	normal	631.25	260.88	109.49	1674.77
U-107	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	7.600	3.8	0.01	40	normal	631.25	260.88	109.49	1674.77
U-108	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
U-109	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	4.100	2.05	0.01	40	normal	631.25	260.88	109.49	1674.77
U-110	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-111	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	8.838	7.1328	0.01	40	normal	631.25	260.88	109.49	1674.77
U-112	SST	1,752.29	410.44	11.430	0.0000	0.000	0.0000	410.44	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-201	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-202	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-203	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59
U-204	SST	200.39	29.19	3.048	0.0000	0.000	0.0000	29.19	2.437	2.4869	0.01	26.5	Lognorm	1143.27	272.08	327.03	2231.59

Data Source		RPP-10006 R5, or based on waste type	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon
Tank #	Tank Type	non- convective waste yield stress dist type (Pa)	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 std dev	Headspace gas ratio CH4 min	Headspace gas ratio CH4 max	Headspace gas ratio CH4 type	Headspace gas ratio N2O mean	Headspace gas ratio N2O mean	Headspace gas ratio N2O std dev	Headspace gas ratio N2O min	Headspace gas ratio N2O max	Headspace gas ratio N2O type	Retained gas composition N2 mean	Retained gas composition N2 mean	Retained gas composition N2 std dev
A-101*	SST	Normal	0.021	0.021	0.001	0.018	0.024	Normal	0.071	0.071	0.005	0.058	0.084	Normal	19.001	19.001	2.326
A-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
A-103	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
A-104	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
A-105	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
A-106	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
AN-101*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AN-102*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AN-103*	DST	Normal	0.09	0.09	0.04	0.02	0.16	Normal	0.05	0.05	0.01	0.04	0.08	Normal	28.66	28.66	5.15
AN-104*	DST	Normal	0.06	0.06	0.01	0.03	0.10	Normal	0.31	0.31	0.03	0.22	0.40	Normal	29.17	29.17	4.92
AN-105*	DST	Normal	0.02	0.02	0.01	0.01	0.04	Normal	0.17	0.17	0.02	0.12	0.22	Normal	24.57	24.57	3.63
AN-106*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AN-107*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-101*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-102*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-103*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-104*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-105*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-106*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-107*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AP-108*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AW-101*	DST	Normal	0.21	0.21	0.02	0.16	0.28	Normal	0.13	0.13	0.02	0.08	0.17	Normal	53.55	53.55	2.71
AW-102*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AW-103*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AW-104*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AW-105*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AW-106*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AX-101	SST	Normal	0.057	0.057	0.007	0.040	0.076	Normal	0.142	0.142	0.008	0.122	0.163	Normal	16.683	16.683	4.284
AX-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
AX-103	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
AX-104*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
AY-101*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AY-102*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AZ-101*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
AZ-102*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
B-101	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
B-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010

Data Source		RPP-10006 R5, or based on waste type	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon
Tank #	Tank Type	non- convective waste yield stress dist type (Pa)	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 std dev	Headspace gas ratio CH4 min	Headspace gas ratio CH4 max	Headspace gas ratio CH4 type	Headspace gas ratio N2O mean	Headspace gas ratio N2O mean	Headspace gas ratio N2O std dev	Headspace gas ratio N2O min	Headspace gas ratio N2O max	Headspace gas ratio N2O type	Retained gas composition N2 mean	Retained gas composition N2 mean	Retained gas composition N2 std dev
BY-112	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-101	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-102*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-103*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-104	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-105	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-106*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-107	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-108*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-109	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-110	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-111	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-112*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-201	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-202	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-203	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
C-204*	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-101	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-102*	SST	Normal	0.020	0.020	0.004	0.012	0.031	Normal	0.481	0.481	0.022	0.414	0.549	Normal	32.246	32.246	3.074
S-103	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-104*	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-105	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-106	SST	Normal	0.013	0.013	0.006	0.000	0.030	Normal	0.131	0.131	0.015	0.098	0.169	Normal	25.217	25.217	3.789
S-107	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-108	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-109	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-110	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
S-111	SST	Normal	0.014	0.014	0.002	0.010	0.019	Normal	0.135	0.135	0.017	0.092	0.190	Normal	20.990	20.990	5.953
S-112*	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-101	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-103	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-104*	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-105	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-106	SST	Normal	0.017	0.017	0.007	0.005	0.034	Normal	0.315	0.315	0.015	0.275	0.360	Normal	20.203	20.203	3.446
SX-107	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-108	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010

Data Source		RPP-10006 R5, or based on waste type	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon
Tank #	Tank Type	non- convective waste yield stress dist type (Pa)	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 std dev	Headspace gas ratio CH4 min	Headspace gas ratio CH4 max	Headspace gas ratio CH4 type	Headspace gas ratio N2O mean	Headspace gas ratio N2O mean	Headspace gas ratio N2O std dev	Headspace gas ratio N2O min	Headspace gas ratio N2O max	Headspace gas ratio N2O type	Retained gas composition N2 mean	Retained gas composition N2 mean	Retained gas composition N2 std dev
SX-109	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-110	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-111	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-112	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-113	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-114	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SX-115	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
SY-101*	DST	Normal	0.07	0.07	0.03	0.01	0.15	Normal	0.36	0.36	0.05	0.23	0.50	Normal	33.87	33.87	6.78
SY-102*	DST	LogNorm	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
SY-103*	DST	Normal	0.05	0.05	0.06	0.00	0.32	LogNorm	0.25	0.25	0.18	0.00	0.62	LogNorm	29.84	29.84	12.01
T-101	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-102	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-103	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-104	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-105	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-106	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-107	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-108	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-109	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-110	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-111	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-112	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-201	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-202	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-203	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
T-204	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-101	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-103	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-104	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-105	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-106	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-107	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-108	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-109	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-110	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-111	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010

Data Source		RPP-10006 R5,or based on waste type	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon
Tank #	Tank Type	non- convective waste yield stress dist type (Pa)	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 mean	Headspace gas ratio CH4 std dev	Headspace gas ratio CH4 min	Headspace gas ratio CH4 max	Headspace gas ratio CH4 type	Headspace gas ratio N2O mean	Headspace gas ratio N2O mean	Headspace gas ratio N2O std dev	Headspace gas ratio N2O min	Headspace gas ratio N2O max	Headspace gas ratio N2O type	Retained gas composition N2 mean	Retained gas composition N2 mean	Retained gas composition N2 std dev
TX-112	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-113	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-114	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-115	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-116	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-117	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TX-118	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TY-101	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TY-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TY-103	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TY-104	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TY-105	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
TY-106	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-101	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-102	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-103	SST	Normal	0.057	0.057	0.011	0.034	0.082	Normal	0.603	0.603	0.015	0.561	0.645	Normal	36.711	36.711	2.018
U-104	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-105	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-106	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-107	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-108	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-109	SST	Normal	0.049	0.049	0.013	0.024	0.087	Normal	0.489	0.489	0.031	0.402	0.577	Normal	46.777	46.777	3.188
U-110	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-111	SST	Normal	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-112	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-201	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-202	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-203	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010
U-204	SST	LogNorm	0.053	0.053	0.056	0.001	0.318	LogNorm	0.253	0.253	0.176	0.001	0.619	LogNorm	29.840	29.840	12.010

Data Source		RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-5926 R7 (Table B-3) & RPP-10006 R5	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	RPP-10006 R5 NonCon	Based on waste phase volumes in RPP-5926 R7 & RPP-10006 R5 See Appendix A
Tank #	Tank Type	Retained gas composition N2 min	Retained gas composition N2 max	Retained gas composition N2 type	Retained gas composition NH3 mean	Retained gas composition NH3 mean	Retained gas composition NH3 std dev	Retained gas composition NH3 min	Retained gas composition NH3 max	Retained gas composition NH3 type	Hydrogen Generation Rate in Non- Convective Waste (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Min (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Max (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Dist Type (moles/m3/d ay)	Cross sectional area of tank (m2)	Waste Type
A-101*	SST	11.352	26.594	Normal	2.457	2.457	0.295	1.242	3.347	Normal	7.70E-05	3.85E-05	1.15E-04	triangular	411.35	SC/SS-NL
A-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.08E-03	4.54E-03	1.73E-02	triangular	411.35	SC/SS-NL
A-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.74E-03	5.80E-04	1.91E-03	triangular	411.35	SC/SS-NL
A-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.50E-03	1.75E-03	6.64E-03	triangular	411.35	SL-NL
A-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.70E-03	1.35E-03	5.13E-03	triangular	411.35	SL-NL
A-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.01E-02	3.36E-03	1.11E-02	triangular	411.35	MIX-NL
AN-101*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.25E-03	6.24E-04	2.37E-03	triangular	409.9	SC/SS-LIQ
AN-102*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	3.45E-03	1.73E-03	5.18E-03	triangular	409.9	SC/SS-LIQ
AN-103*	DST	14.91	42.80	Normal	0.60	0.60	0.07	0.40	0.78	Normal	9.41E-04	4.70E-04	1.79E-03	triangular	409.9	SC/SS-LIQ
AN-104*	DST	14.33	41.44	Normal	0.88	0.88	0.13	0.38	1.29	Normal	1.44E-03	7.21E-04	2.16E-03	triangular	409.9	SC/SS-LIQ
AN-105*	DST	14.17	34.34	Normal	0.50	0.50	0.06	0.30	0.76	Normal	8.66E-04	4.33E-04	1.64E-03	triangular	409.9	SC/SS-LIQ
AN-106*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.45E-02	4.83E-03	1.59E-02	triangular	409.9	SL-LIQ
AN-107*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	3.45E-03	1.15E-03	3.80E-03	triangular	409.9	SC/SS-LIQ
AP-101*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	3.34E-04	1.67E-04	6.35E-04	triangular	409.9	LIQ
AP-102*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.25E-03	6.27E-04	2.38E-03	triangular	409.9	SL-LIQ
AP-103*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.78E-03	8.90E-04	3.38E-03	triangular	409.9	SL-LIQ
AP-104*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.13E-03	5.66E-04	1.70E-03	triangular	409.9	SC/SS-LIQ
AP-105*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	7.78E-04	3.89E-04	1.48E-03	triangular	409.9	SC/SS-LIQ
AP-106*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.13E-03	5.66E-04	1.70E-03	triangular	409.9	SC/SS-LIQ
AP-107*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	9.76E-04	4.88E-04	1.85E-03	triangular	409.9	SC/SS-LIQ
AP-108*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	6.13E-04	3.07E-04	1.16E-03	triangular	409.9	SC/SS-LIQ
AW-101*	DST	45.45	62.01	Normal	0.57	0.57	0.10	0.27	0.96	Normal	1.14E-03	5.72E-04	2.17E-03	triangular	409.9	SC/SS-LIQ
AW-102*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	4.37E-03	2.19E-03	8.30E-03	triangular	409.9	SL-LIQ
AW-103*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	3.39E-04	1.70E-04	6.45E-04	triangular	409.9	SL-LIQ
AW-104*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	6.91E-04	3.46E-04	1.31E-03	triangular	409.9	SC/SS-LIQ
AW-105*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.13E-03	5.66E-04	2.15E-03	triangular	409.9	SL-LIQ
AW-106*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	8.03E-04	4.01E-04	1.53E-03	triangular	409.9	SC/SS-LIQ
AX-101	SST	4.648	27.392	Normal	6.585	6.585	1.769	3.094	10.784	Normal	1.23E-03	6.15E-04	1.85E-03	triangular	410.66	SC/SS-NL
AX-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.90E-03	3.95E-03	1.50E-02	triangular	410.66	SC/SS-NL
AX-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.52E-03	1.76E-03	6.69E-03	triangular	410.66	SC/SS-NL
AX-104*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.88E-03	9.38E-04	3.56E-03	triangular	410.66	SL-NL
AY-101*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	2.10E-02	6.99E-03	2.31E-02	triangular	410.4	SL-LIQ
AY-102*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	6.48E-02	2.16E-02	7.13E-02	triangular	410.4	SL-LIQ
AZ-101*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	5.99E-02	2.00E-02	6.59E-02	triangular	409.9	SL-LIQ
AZ-102*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	7.86E-02	2.62E-02	8.65E-02	triangular	409.9	SL-LIQ
B-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.54E-03	7.69E-04	2.92E-03	triangular	410.43	SC/SS-NL
B-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.50E-03	1.75E-03	6.65E-03	triangular	410.43	SC/SS-NL

Data Source		RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-5926 R7 (Table B-3) & RPP-10006 R5	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	RPP-10006 R5 NonCon	Based on waste phase volumes in RPP-5926 R7 & RPP-10006 R5 See Appendix A
Tank #	Tank Type	Retained gas composition N2 min	Retained gas composition N2 max	Retained gas composition N2 type	Retained gas composition NH3 mean	Retained gas composition NH3 mean	Retained gas composition NH3 std dev	Retained gas composition NH3 min	Retained gas composition NH3 max	Retained gas composition NH3 type	Hydrogen Generation Rate in Non- Convective Waste (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Min (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Max (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Dist Type (moles/m3/d ay)	Cross sectional area of tank (m2)	Waste Type
B-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.84E-03	9.22E-04	3.50E-03	triangular	410.43	SC/SS-NL
B-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.15E-04	2.07E-04	7.88E-04	triangular	410.43	SL-NL
B-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.80E-04	2.40E-04	9.11E-04	triangular	410.43	SC/SS-NL
B-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.07E-03	5.33E-04	2.03E-03	triangular	410.43	SL-NL
B-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.48E-04	3.74E-04	1.42E-03	triangular	410.43	MIX-NL
B-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.18E-03	5.88E-04	2.23E-03	triangular	410.43	SC/SS-NL
B-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.05E-04	4.52E-04	1.72E-03	triangular	410.43	MIX-NL
B-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.49E-04	4.74E-04	1.80E-03	triangular	410.43	SL-NL
B-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.41E-03	7.04E-04	2.67E-03	triangular	410.43	SL-NL
B-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.51E-03	1.75E-03	6.66E-03	triangular	410.43	MIX-NL
B-201	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.76E-04	4.38E-04	1.66E-03	triangular	29.19	SL-NL
B-202*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.60E-05	1.80E-05	6.85E-05	triangular	29.19	SL-NL
B-203	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.78E-03	8.89E-04	3.38E-03	triangular	29.19	SL-NL
B-204	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.79E-03	8.95E-04	3.40E-03	triangular	29.19	SL-NL
BX-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.41E-03	1.20E-03	4.58E-03	triangular	410.43	SL-NL
BX-102*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.42E-05	4.21E-05	1.60E-04	triangular	410.43	SL-NL
BX-103*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.33E-04	1.17E-04	4.43E-04	triangular	410.43	SL-NL
BX-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.61E-03	8.03E-04	3.05E-03	triangular	410.43	SL-NL
BX-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.78E-03	8.92E-04	3.39E-03	triangular	410.43	MIX-NL
BX-106*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.62E-04	8.11E-05	3.08E-04	triangular	410.43	SC/SS-NL
BX-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.10E-04	2.55E-04	9.69E-04	triangular	410.43	SL-NL
BX-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.32E-03	1.66E-03	6.31E-03	triangular	410.43	SL-NL
BX-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.13E-03	5.63E-04	2.14E-03	triangular	410.43	SL-NL
BX-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.80E-04	3.90E-04	1.48E-03	triangular	410.43	MIX-NL
BX-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.62E-04	3.31E-04	1.26E-03	triangular	410.43	SC/SS-NL
BX-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.84E-04	4.42E-04	1.68E-03	triangular	410.43	SL-NL
BY-101*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.02E-05	1.51E-05	5.74E-05	triangular	410.43	SC/SS-NL
BY-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.37E-04	2.69E-04	1.02E-03	triangular	410.43	SC/SS-NL
BY-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.48E-04	2.24E-04	8.50E-04	triangular	410.43	SC/SS-NL
BY-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.75E-04	3.37E-04	1.28E-03	triangular	410.43	SC/SS-NL
BY-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.15E-04	2.57E-04	9.78E-04	triangular	410.43	SC/SS-NL
BY-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.60E-04	3.30E-04	1.25E-03	triangular	410.43	SC/SS-NL
BY-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.22E-04	3.61E-04	1.37E-03	triangular	410.43	SC/SS-NL
BY-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.06E-04	4.03E-04	1.53E-03	triangular	410.43	SC/SS-NL
BY-109	SST	16.678	42.377	Normal	0.191	0.191	0.034	0.081	0.321	Normal	5.23E-04	2.62E-04	9.94E-04	triangular	410.43	SC/SS-NL
BY-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.42E-03	7.08E-04	2.13E-03	triangular	410.43	SC/SS-NL
BY-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.07E-04	2.03E-04	7.72E-04	triangular	410.43	SC/SS-NL

Data Source		RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-5926 R7 (Table B-3) & RPP-10006 R5	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	RPP-10006 R5 NonCon	Based on waste phase volumes in RPP-5926 R7 & RPP-10006 R5 See Appendix A
Tank #	Tank Type	Retained gas composition N2 min	Retained gas composition N2 max	Retained gas composition N2 type	Retained gas composition NH3 mean	Retained gas composition NH3 mean	Retained gas composition NH3 std dev	Retained gas composition NH3 min	Retained gas composition NH3 max	Retained gas composition NH3 type	Hydrogen Generation Rate in Non- Convective Waste (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Min (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Max (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Dist Type (moles/m3/d ay)	Cross sectional area of tank (m2)	Waste Type
BY-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.11E-04	2.55E-04	9.70E-04	triangular	410.43	SC/SS-NL
C-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.53E-03	7.63E-04	2.90E-03	triangular	410.43	SL-NL
C-102*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.76E-05	1.38E-05	5.24E-05	triangular	410.43	SL-NL
C-103*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.58E-03	2.29E-03	8.71E-03	triangular	410.43	SL-NL
C-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.61E-03	8.70E-04	2.87E-03	triangular	410.43	SL-NL
C-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.61E-03	1.30E-03	4.96E-03	triangular	410.43	SL-NL
C-106*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.64E-03	3.32E-03	1.26E-02	triangular	410.43	SL-NL
C-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.75E-03	1.58E-03	5.23E-03	triangular	410.43	SL-NL
C-108*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.90E-04	9.49E-05	3.61E-04	triangular	410.43	SL-NL
C-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.74E-03	2.37E-03	9.00E-03	triangular	410.43	SL-NL
C-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.77E-03	8.85E-04	3.36E-03	triangular	410.43	SL-NL
C-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.09E-02	5.43E-03	1.63E-02	triangular	410.43	SL-NL
C-112*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.40E-04	1.20E-04	3.60E-04	triangular	410.43	SL-NL
C-201	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.23E-02	6.15E-03	2.34E-02	triangular	29.19	SL-NL
C-202	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.95E-03	2.97E-03	1.13E-02	triangular	29.19	SL-NL
C-203	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.34E-01	6.71E-02	2.55E-01	triangular	29.19	SL-NL
C-204*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.67E-03	2.83E-03	1.08E-02	triangular	29.19	SL-NL
S-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.22E-03	6.12E-04	1.84E-03	triangular	410.43	MIX-NL
S-102*	SST	23.974	40.719	Normal	0.932	0.932	0.288	0.347	1.624	Normal	1.59E-04	7.93E-05	3.01E-04	triangular	410.43	MIX-NL
S-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.16E-04	4.58E-04	1.74E-03	triangular	410.43	SC/SS-NL
S-104*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.77E-05	1.88E-05	7.16E-05	triangular	410.43	MIX-NL
S-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.92E-04	1.96E-04	7.45E-04	triangular	410.43	SC/SS-NL
S-106	SST	15.249	34.922	Normal	0.299	0.299	0.067	0.094	0.520	Normal	4.98E-04	2.49E-04	9.46E-04	triangular	410.43	SC/SS-NL
S-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.48E-04	4.24E-04	1.61E-03	triangular	410.43	SL-NL
S-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.33E-04	1.66E-04	6.33E-04	triangular	410.43	SC/SS-NL
S-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.48E-04	1.74E-04	6.62E-04	triangular	410.43	SC/SS-NL
S-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.08E-04	3.04E-04	1.15E-03	triangular	410.43	SC/SS-NL
S-111	SST	4.556	34.751	Normal	0.929	0.929	0.285	0.355	1.603	Normal	7.49E-04	3.74E-04	1.42E-03	triangular	410.43	SC/SS-NL
S-112*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.38E-03	2.69E-03	1.02E-02	triangular	410.43	SC/SS-NL
SX-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.14E-04	3.57E-04	1.36E-03	triangular	410.66	MIX-NL
SX-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.97E-03	6.56E-04	2.16E-03	triangular	410.66	SC/SS-NL
SX-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.94E-03	1.65E-03	5.44E-03	triangular	410.66	SC/SS-NL
SX-104*	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.10E-05	2.03E-05	6.70E-05	triangular	410.66	MIX-NL
SX-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.85E-03	1.95E-03	6.44E-03	triangular	410.66	SC/SS-NL
SX-106	SST	10.198	29.551	Normal	4.202	4.202	1.255	1.790	6.805	Normal	8.67E-04	4.33E-04	1.65E-03	triangular	410.66	SC/SS-NL
SX-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.68E-03	2.84E-03	8.52E-03	triangular	410.66	SL-NL
SX-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.69E-03	1.34E-03	5.11E-03	triangular	410.66	SL-NL

Data Source		RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-5926 R7 (Table B-3) & RPP-10006 R5	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	RPP-10006 R5 NonCon	Based on waste phase volumes in RPP-5926 R7 & RPP-10006 R5 See Appendix A
Tank #	Tank Type	Retained gas composition N2 min	Retained gas composition N2 max	Retained gas composition N2 type	Retained gas composition NH3 mean	Retained gas composition NH3 mean	Retained gas composition NH3 std dev	Retained gas composition NH3 min	Retained gas composition NH3 max	Retained gas composition NH3 type	Hydrogen Generation Rate in Non- Convective Waste (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Min (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Max (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Dist Type (moles/m3/d ay)	Cross sectional area of tank (m2)	Waste Type
SX-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.67E-03	1.22E-03	4.03E-03	triangular	410.66	SC/SS-NL
SX-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.76E-02	5.87E-03	1.94E-02	triangular	410.66	SL-NL
SX-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.52E-03	2.51E-03	8.27E-03	triangular	410.66	SL-NL
SX-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.08E-03	2.54E-03	9.65E-03	triangular	410.66	SL-NL
SX-113	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.32E-03	2.66E-03	1.01E-02	triangular	410.66	SL-NL
SX-114	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.30E-03	2.10E-03	6.93E-03	triangular	410.66	SL-NL
SX-115	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.51E-02	1.75E-02	6.67E-02	triangular	410.66	SL-NL
SY-101*	DST	13.36	53.31	Normal	9.17	9.17	2.99	3.27	15.77	Normal	7.96E-04	3.98E-04	1.51E-03	triangular	409.9	SC/SS-LIQ
SY-102*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	2.15E-03	1.08E-03	4.09E-03	triangular	409.9	SL-LIQ
SY-103*	DST	4.50	80.00	LogNorm	0.25	0.25		0.01	18.32	ContLin	1.95E-03	9.74E-04	2.92E-03	triangular	409.9	SC/SS-LIQ
T-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.27E-03	6.36E-04	2.42E-03	triangular	410.43	MIX-NL
T-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.30E-02	6.51E-03	2.47E-02	triangular	410.43	SL-NL
T-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.29E-03	2.14E-03	8.15E-03	triangular	410.43	SL-NL
T-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.89E-04	2.45E-04	9.30E-04	triangular	410.43	SL-NL
T-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.41E-03	7.03E-04	2.67E-03	triangular	410.43	SL-NL
T-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.51E-03	2.25E-03	8.56E-03	triangular	410.43	SL-NL
T-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.05E-03	5.27E-04	2.00E-03	triangular	410.43	SL-NL
T-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.07E-03	3.04E-03	1.15E-02	triangular	410.43	MIX-NL
T-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.66E-03	8.32E-04	3.16E-03	triangular	410.43	SC/SS-NL
T-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.02E-03	5.12E-04	1.95E-03	triangular	410.43	SL-NL
T-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.10E-04	2.05E-04	7.79E-04	triangular	410.43	SL-NL
T-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.75E-03	8.77E-04	3.33E-03	triangular	410.43	SL-NL
T-201	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.08E-03	1.04E-03	3.95E-03	triangular	29.19	SL-NL
T-202	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.28E-04	4.64E-04	1.76E-03	triangular	29.19	SL-NL
T-203	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.89E-04	3.95E-04	1.50E-03	triangular	29.19	SL-NL
T-204	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.88E-04	3.94E-04	1.50E-03	triangular	29.19	SL-NL
TX-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.74E-03	8.71E-04	3.31E-03	triangular	410.43	SL-NL
TX-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.57E-04	3.28E-04	1.25E-03	triangular	410.43	SC/SS-NL
TX-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.77E-04	4.39E-04	1.67E-03	triangular	410.43	SC/SS-NL
TX-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.96E-03	9.81E-04	3.73E-03	triangular	410.43	MIX-NL
TX-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.54E-04	1.77E-04	6.72E-04	triangular	410.43	SC/SS-NL
TX-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.12E-04	2.56E-04	9.72E-04	triangular	410.43	SC/SS-NL
TX-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.55E-03	1.77E-03	6.74E-03	triangular	410.43	SC/SS-NL
TX-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.30E-04	4.65E-04	1.77E-03	triangular	410.43	SC/SS-NL
TX-109	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.04E-04	3.02E-04	1.15E-03	triangular	410.43	SL-NL
TX-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.82E-04	1.91E-04	7.26E-04	triangular	410.43	SC/SS-NL
TX-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	4.37E-04	2.18E-04	8.30E-04	triangular	410.43	SC/SS-NL

Data Source		RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-10006 R5 NonCon	RPP-5926 R7 (Table B-3) & RPP-10006 R5	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	Calculated Value RPP-10006 See Appendix E	RPP-10006 R5 NonCon	Based on waste phase volumes in RPP-5926 R7 & RPP-10006 R5 See Appendix A
Tank #	Tank Type	Retained gas composition N2 min	Retained gas composition N2 max	Retained gas composition N2 type	Retained gas composition NH3 mean	Retained gas composition NH3 mean	Retained gas composition NH3 std dev	Retained gas composition NH3 min	Retained gas composition NH3 max	Retained gas composition NH3 type	Hydrogen Generation Rate in Non- Convective Waste (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Min (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Max (moles/m3/d ay)	Hydrogen Generation Rate in Non- Convective Waste Dist Type (moles/m3/d ay)	Cross sectional area of tank (m2)	Waste Type
TX-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.28E-04	1.64E-04	6.23E-04	triangular	410.43	SC/SS-NL
TX-113	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.04E-04	1.52E-04	5.77E-04	triangular	410.43	SC/SS-NL
TX-114	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.39E-04	1.69E-04	6.44E-04	triangular	410.43	SC/SS-NL
TX-115	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.39E-04	1.70E-04	6.45E-04	triangular	410.43	SC/SS-NL
TX-116	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.12E-04	1.56E-04	5.93E-04	triangular	410.43	SC/SS-NL
TX-117	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.51E-04	1.75E-04	6.67E-04	triangular	410.43	SC/SS-NL
TX-118	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	8.02E-04	4.01E-04	1.52E-03	triangular	410.43	SC/SS-NL
TY-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.50E-04	4.75E-04	1.80E-03	triangular	410.43	MIX-NL
TY-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.55E-03	7.77E-04	2.95E-03	triangular	410.43	SC/SS-NL
TY-103	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.37E-04	4.69E-04	1.78E-03	triangular	410.43	MIX-NL
TY-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.76E-03	1.38E-03	5.24E-03	triangular	410.43	SL-NL
TY-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.30E-04	4.65E-04	1.77E-03	triangular	410.43	SL-NL
TY-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	6.31E-03	3.15E-03	1.20E-02	triangular	410.43	SL-NL
U-101	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	5.32E-03	2.66E-03	1.01E-02	triangular	410.43	SL-NL
U-102	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.20E-03	5.98E-04	2.27E-03	triangular	410.43	SC/SS-NL
U-103	SST	30.945	42.561	Normal	0.596	0.596	0.156	0.246	0.963	Normal	1.24E-03	6.19E-04	1.86E-03	triangular	410.43	SC/SS-NL
U-104	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.64E-03	8.22E-04	3.12E-03	triangular	410.43	SL-NL
U-105	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.15E-03	5.77E-04	2.19E-03	triangular	410.43	SC/SS-NL
U-106	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.27E-03	1.13E-03	4.31E-03	triangular	410.43	SC/SS-NL
U-107	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	7.47E-04	3.74E-04	1.42E-03	triangular	410.43	SC/SS-NL
U-108	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.28E-04	4.64E-04	1.76E-03	triangular	410.43	SC/SS-NL
U-109	SST	36.854	56.618	Normal	1.007	1.007	0.328	0.354	1.812	Normal	7.82E-04	3.91E-04	1.49E-03	triangular	410.43	SC/SS-NL
U-110	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.19E-03	5.96E-04	2.26E-03	triangular	410.43	SL-NL
U-111	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	9.08E-04	4.54E-04	1.72E-03	triangular	410.43	SC/SS-NL
U-112	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.76E-03	1.38E-03	5.23E-03	triangular	410.43	SL-NL
U-201	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	2.86E-03	1.43E-03	5.44E-03	triangular	29.19	SL-NL
U-202	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.09E-03	1.55E-03	5.87E-03	triangular	29.19	SL-NL
U-203	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	3.37E-03	1.69E-03	6.41E-03	triangular	29.19	SL-NL
U-204	SST	4.500	80.000	LogNorm	0.250	0.250		0.010	18.318	ContLin	1.04E-02	5.22E-03	1.98E-02	triangular	29.19	SL-NL

H4.0 REFERENCES

- OSD-T-151-00007, 2007, *Operating Specifications for the Double-Shell Storage Tanks*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.
- Personal Computer Surveillance Analysis Computer System (PCSACS) 2005, Surveillance Analysis Computer System, queried 11/22/2005, [Interstitial Liquid Level Reading], HISI ID No. 242, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-5926, 2005, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-5926, 2007, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 7, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6655, 2000, *Data Observations on Double-Shell Flammable Gas Watch List Tank Behavior*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-7625, 2006, *Best-Basis Inventory Process Requirements*, Rev. 6, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-10006, 2006, *Methodology and Calculations for the Waste Groups for Large Underground Waste Storage Tanks at the Hanford Site*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-13019, 2003, *Determination of Hanford Waste Tank Volumes*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-29167, 2006, *Spreadsheet Description Document for RPP-10006 Rev 5 Data Rebuild 060306.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.
- SVF-1118, 2006, *Spreadsheet Verification & Release Form for Spreadsheet RPP-10006 Rev 5 Data Rebuild 060306.xls*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

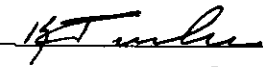
This page intentionally left blank.

APPENDIX I

PEER REVIEW CHECKLIST

This page intentionally left blank.

Peer Review Checklist

Calculation Reviewed: RPP-10006, Rev. 7Scope of Review: Entire document except Appendices F and G which remained unchanged from previous revision.Engineer/Analyst: K. D. Fowler  Date: 12/21/07Organizational Manager: N. W. Kirch  Date: 12/21/2007This document consists of 252 pages and the following attachments (if applicable):

Yes No NA*

- | | | | | |
|-------------------------------------|--------------------------|--------------------------|-----|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1. | Analytical and technical approaches and results are reasonable and appropriate. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2. | Necessary assumptions are reasonable, explicitly stated, and supported. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3. | Ensure calculations that use software include a paper printout, microfiche, CD ROM, or other electronic file of the input data and identification to the computer codes and versions used, or provide alternate documentation to uniquely and clearly identify the exact coding and execution process. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4. | Input data were checked for consistency with original source information. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. | Key input data (e.g., dimensions, performance characteristics) that may affect equipment design is identified. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 6. | For both qualitative and quantitative data, uncertainties are recognized and discussed and the data is presented in a manner to minimize design interpretations. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 7. | Mathematical derivations were checked, including dimensional consistency of results. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 8. | Calculations are sufficiently detailed such that a technically qualified person can understand the analysis without requiring outside information. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 9. | Software verification and validation are addressed adequately. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10. | Limits/criteria/guidelines applied to the analysis results are appropriate and referenced. Limits/criteria/guidelines were checked against references. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 11. | Conclusions are consistent with analytical results and applicable limits. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 12. | Results and conclusions address all points in the purpose. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 13. | Referenced documents are retrievable or otherwise available. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 14. | The version or revision of each reference is cited. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 15. | The document was prepared in accordance with Attachment A, "Calculation Format and Preparation Instructions." |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 16. | Impacts on requirements have been assessed and change documentation initiated to incorporate revisions to affected documents, as appropriate. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 17. | All checker comments have been dispositioned and the design media matches the calculations. |

J. E. Meacham 

Checker (printed name and signature)

12/21/2007
Date

*Waste groups in HNF-IP-1266 for DSTs based on waste compatibility analyses and pending transfers and will not be updated to reflect results shown here. Tank 241-SX-104 moved from Waste Group C to Waste Group B. This change is pending.

This page intentionally left blank